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ROYAL ASIATIC SOCIETY.

Edited by the Secretary

VOL. V.

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PREFACE.

IN concluding the Fifth Volume of the Society's Journal, the Editor would take this opportunity of acknowledging, with grateful thanks, the assistance he has derived from the different gentlemen who have contributed to the publication since he has had the honour to be *Secretary* of the Society ; more particularly to the Rev. Drs. Wilson and Stevenson, the former *Honorary President*, and the latter late *President* of the Society, to whose exertions and willingness at all times to aid in the management of the Society, and the advancement of its objects, independently of their valuable contributions to the Journal, the Society must ever remain indebted.

While availing himself of this opportunity also to apologize for the delay which has attended the publication of the last Number, the Editor would observe, that it has been occasioned by an increase of duty over which he had no control ; but he trusts that ere long the Society will, by the assistance of Government, be enabled to provide against such contingencies, and thus find means of insuring that stability and competence in the performance of its *Secretary's* duties, without which the best endeavours of the Society must always be dependent on chance or a successful issue.

Bombay, 1st July 1857.

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JOURNAL
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JANUARY, 1855.

ART. I.—*The Tithyas or Tirthakas of the Buddhists, and the Gymnosophsists of the Greeks, Digambar Jains.* By the Rev.
J. STEVENSON, D.D., President.

Read October 20th 1853.

ALTHOUGH much obscurity still rests upon the Buddhist religion, especially in reference to its rise, and the relation it holds to other systems. As prevalent in India, light has of late begun to break in upon this interesting subject. The publication of Burnouf's History of Buddhism, embodying large extracts from original documents now existing in Nepaul, of which copies were transmitted by Mr. Hodgson to Europe, and the translation of similar documents found in Ceylon by Mr. Hardy, furnish unquestionable proof, that when Buddhism sprung up, five and a half centuries before the Christian era, the whole of Indian society was under the influence of the present Brâhmanical institutions; and to me it appears as evident that Jainism had begun that opposition to the prevalent ceremonial system, which was afterwards more vigorously carried on under the banners of Buddhism. Slaves as the Hindus at first sight appear to be to priestly domination, there has always been, and still is, a party among them opposed to the

dictation of the Bráhmans, and seeking something more spiritual and liberal than their ritual affords.

It is a singular fact that the first innovations on the ancient ceremonial system are traced back both by Bráhmans and Jains to Rishabha a sovereign who stands near the top of the list of their heroic kings and father of that Bharta, from whom India received its indigenous name ; and who, according to the most moderate computation, must have lived four thousand years ago. The account given of him in the Bhágavat, the great Bráhmanical authority, is the following :—

" After having installed Bharat, the eldest of his hundred sons, in the sovereignty over the earth, this accomplished servant of the Lord and friend of man, devoted himself to God. Preserving nothing that belonged to him, with his body naked, his hair disordered, and like one deranged, having drunk the ashes of the consecrated fire, he went forth as a mendicant in the land of the Bráhmans." *

The Jain account of Rishabha, in the Kalpa Sútra, is that he was "the first king, the first mendicant, and the first Tirthankara." † It is also said that " Achailakya (want of clothing) is the attribute among the Tirthankaras of Rishabha and Mahavíra alone." ‡

How far any regularly organized and permanent opposition to the ancient ceremonial took place at this early period cannot with certainty be determined. The probability is that ritualism and liberalism were both then, and long after, without system. The next great opponent after Rishabha to the prevalent ceremonialism, as far as we can gather from the tradition of those times, was Kapila ; but although the spirit of his philosophy is in direct contradiction to the Vedas,—the only sacred books that seem to have existed among the Bráhmans in his time,—he never separated himself from the religious community, and his influence was too great to permit of this being effected by others. Modern Hindú writers, however, have denounced his system, in which everything is deduced from nature, without the intervention of a deity, as dangerous, and called it the atheistical Sankhya. This is the scheme of philosophy that was anciently so popular among ... Buddhists and Jains ; and the Bráhmans, in order to adapt it to theism, added a deity, to whom they assigned the heartless task of looking on unconcerned while nature was evolving from her fertile womb the elements of things.

* Bhágavat Purána, book v. chap. v. 28.

† Translation of Kalpa Sútra, chap. vii.

‡ Translation of Kalpa Sútra, Introduction, p. 3.

The town of Kapilavasta, named after this sage, was famous in ancient times, and we have no good reason to doubt that Kapila was a historical personage, though the time in which he lived is involved, like most subjects of Hindú chronology, in almost impenetrable obscurity ; yet the place he holds in Indian tradition leads us to conjecture that he flourished above a thousand years before our era.

After Kapila the next liberal philosopher who exerted a great influence on the mind of India was Parshvanáth, the author of the Jain religious system, who flourished eight and a half centuries before the Christian era. According to the Jains, he was the son of a king of Benares, lived a hundred years, and died n. c. 828. He is reckoned twenty-third in the number of their Tirthankaras, has temples specially dedicated to him, and is held, with Rishabha and Mahavíra, still in special veneration. Among the Hindús generally he is much better known as the object of Jain reverence than any of the rest of their sages, and is alone specially invoked in the introduction to the most sacred of Jain works, the Kalpa Sútra ; leading to the idea that he is the real founder of the sect.

After him, the next great teacher of the Jain system was Vardhamána, styled Mahavíra (the great hero), son of Siddhártha, the petty raja of Kundagrámá, a town and district in Behár. His death took place n. c. 569, at the age of seventy. His chief disciple at that time was Gotama Indrabhútí, destined to become the famous Buddha, and to spread the religion of human reason and asceticism more widely in Eastern Asia than has happened to any other religious system. Mahavíra had innovated on the system of his predecessors, and to show his entire freedom from human passions, dispensed with the mean apparel which, for the sake of decency, ascetics till then continued to wear. After his death a split took place among the members of the Jain community, the majority adhering with Sudharma to the system of their preceptor, but an influential minority, with Gotama at their head, returning to the institute of Parshvanáth in respect of decent apparel.

Lists of the head teachers of the disciples of Mahavíra, or original Jains, have been handed down to us, of so trustworthy a character, and bearing so much internal evidence of truth, that it is impossible to deny their genuineness, as any one may satisfy himself by looking into the Sthirávali of the Kalpa Sútra ; but owing to the prevalence of Buddhism for several centuries after its rise, Jainism, though not extinct, sank into comparative obscurity.

Gotama, the Jains maintain, was originally a Bráhman, but the

dicts
liber
Buddhists affirm that he was the son of Suddhodhana, a petty raja in Behár. However this may be, we cannot allow him the merit or

demerit, as the case may be considered, of inventing the system he so widely propagated. The Buddhists themselves mention five other ascetics, no doubt belonging to the Jain minority, who consorted with Gotama before he became Buddha. These, it is true, for a time deserted him, but they all returned on his attaining Buddhahood, and proved exceedingly useful to him in the propagation of his system. The essential elements of both his system and that of the Jains is the philosophy of Kapila—the deification of nature; a spiritu-material pantheism, with the peculiarity that certain natural elements are capable of pressing themselves forward, so as to acquire omniscience. These extraordinary beings are called by the Jains Tirthankaras, and by the others Buddhas.

In thus adopting in the main the Jain account as that based on fact, in opposition to the account of the rise of Buddhism given by its own adherents,^{*} I was guided at first solely by the consideration that the Jains give us probable facts, and dates, and terms of human life,

back to n. c. 828, while the Buddhists do so only to n. c. 513; but the following considerations, taken from Buddhist documents themselves, will fully confirm the previous existence of the Jains as a religious party.

In the Buddhist documents preserved in the north of India, and analyzed by Burnouf, and in the Ceylonese writings translated by Hardy, frequent mention is made of a class of opponents encountered by Buddha, usually named Tithyas or Tirthakas. This word, however, is used synonymously with Tirthankara, the Sanskrit form of the word Tirthankara, a name appropriated by the Jains to their deified religious legislators.* In several passages the Tithyas are distinguished both from Bráhmaṇas and Buddhists. Thus Raktaśha is said to have gone to a place where there were Tirthakas, S'rāmanas, and Bráhmaṇas, ascetics and mendicants.† Not having the original before me, I can only conjecture that the two last mentioned parties were Váuprasthas, and Sanyásis, and the third common Bráhmaṇa householders. The second were certainly Buddhist ascetics; and it seems to me there can be as little doubt but that the first were Jains. In the same way, in the Lalita Vistara, the Tirthakas are mentioned among the auditors of Buddha as a sect different from the Bráhmaṇas, in a passage in which, perhaps, the original terms are the same as those of the passage cited

* Burnouf, *Histoire du Buddhism*, vol. i. p. 515, and onward.

† Burnouf, p. 172.

above.* In Turnour's Páli Buddhistic Annals the Tithyas are also mentioned, and named heretics.† In the Buddhist documents the Bráhmans are always correctly described, and well characterized, as in the following passage, where Buddha, after partaking of a feast prepared by a Bráhman for him and his disciples, is said to have spoken as follows :—“ As the offering of the Bráhmans cannot be presented without fire, unto him fire is the principle requisite : as a knowledge of the science of recitation is required by him who recites the Vedas ; as the king is the chief of men ; as all rivers are received by the sea ; as the sun and moon are necessary to the science of the astronomer, so to him who would acquire merit by the giving of alms Buddha and his priests are the principal requisites.” ‡

Again, Buddha and his priests on a certain occasion are said to have fallen in with a certain ascetic Bráhman called Bawari, who taught “the three Vedas,” but neither he nor any other Bráhman is ever called a Tirthaka. The authors of those books, then, knew full well what a Bráhman was, and describe him as we now find him. Let us next see how they describe the Tirthakas.

One of the principal Tirthaka opponents of Buddha is thus censured by a favourer of Buddhism :—“ Comment pent-il être sage celui qui, portant les signes de la virilité, &c. promène un dans le village, aux yeux des peuples ? Celui qui suit la loi couvre le devant de son corps d'un vêtement.” §

In Harvey's Manual of Buddhism we are told that this Purána was called also “ Purná-Kasyapa-Buddha, because he had overcome all evil desire.”

Further, it is said—“ The people brought him clothes in abundance, but he refused them, as he thought if he put them on he would not be treated with the same respect. ‘ Clothes,’ said he, ‘ are for the covering of shame ; shame is the effect of sin ; I am a *rahat*, and as I am free from evil desire, I know no shame.’ The people believed what he said, and worshipped him. Five hundred other persons became his disciples, and it was proclaimed throughout all Jam-budvipa that he was Buddha.” ||

It is noticed particularly of another Tirthaka opponent of Buddha,

* Laṅka Vistara, Cal. edn. p. 2, l. 3 from the bottom. The words are as follows :—
अन्यतीर्थिक अमण ब्राह्मण चरक परिवाजकान्. Jains, Buddhists, Bráhmans, eremites, and mendicants from other quarters.

† Jour. As. Soc. Bengal, vols. vi. and vii.

‡ Burnouf, p. 275.

§ Burnouf, pp. 187, 188.

|| Harvey, p. 291.

dict that he wore no clothes.* A third boiled all his water ere he drank it, and a fourth condemned the eating of flesh.†

I There are two grand characteristics, then, of those Tirthakas, which
nial are in exact agreement with the oldest books and traditions of the
a so Jains—the existence among them of Digambar sages, and the total
and abstinence from animal food. Neither of these are applicable to either
narr the Bráhmans or Buddhists of ancient times.

hav In all the Bráhmanical works no follower of the religion of the
Bhá Vedas is mentioned, with the single exception of Rishabha, who went
about unclothed. Against following his example the Bhágavat puts
the in an express caution, and says that those who now do so “are in-
and fatuated by necessity, under the evil influence of the Kali age.”‡

bel The Vishnu Purána, when it describes Vishnu as assuming the form
one of a sage to deceive mankind, describes him as a Digambar Jain, in
fort the semblance of a naked mendicant, with his head shaven, and
carrying a bunch of peacocks' feathers.§

“ t The Jaïfs are evidently intended in this passage, though it is usual
also to say that the ignorance of the Hindú annualist has led him to con-
the found them with the Buddhists.

] In Manu the ascetics of the third or Vánprastha division of Brá-
anc mams are directed to clothe themselves with the “ skin of an antelope
cer or the bark of a tree,” and the Sanyásî or fourth order are also direct'd
libt to be dressed in “ coarse clothing.”||

gre Hodgson, indeed, mentions that there is an isoteric or tantrical
as theory of Buddhism known in Nepaul, the pictures representing the
atl sages of which make them appear as entirely unclothed ; but no such
Vet sages are acknowledged among the pure Buddhists of the present day ;
Brâ and the adoption of such a usage is entirely in opposition to the
cor practice and precepts of Buddha, as contained in the documents
effe transmitted to M. Burnouf by Mr. Hodgson himself, which expressly
his condemn the Tirthakas for this very practice.

int In reference to abstinence from animal food, this seems to have been
Sau an original institute of the Jains, or at least early introduced by them.
po] Buddha would not kill an animal, it is true, for food, but he would eat
to its flesh, and the last meal he partook of was a dish of pork, prepared
les by a disciple named Chundo.¶ According to Manu, the feast in honour
fer

* Harvey, p. 330. † Harvey, p. 292. ‡ Bhagavat, books v. and vi. 2.

§ Vishnu Purána, books iii. and xviii. || Manu, book vi. 6, 44.

¶ Turnour. Jour. As. Soc. Bengal, vol. vii. p. 1003. This fact is also noticed in Burnouf and Harvey.

of deceased ancestors could not be honourably celebrated without a number of kinds of flesh, and the fatted calf was killed to entertain a distinguished guest among the ancient Bráhmans as well as among the Jews.*

The Tirthakas of the Buddhists, then, could be none but Digambar Jains ; and the very same considerations show that the Gymnosophists of the Greeks must have belonged to the same class. They could neither have been Bráhmans nor Buddhists, but such sages as are described in the *Kalpa Sútra* and other Jain works, successors of whom are still met with on Mount A'bú, and the districts adjoining. Clement of Alexandria, the most accurate Greek writer on foreign matters, expressly distinguishes the *Σεμνοί* or Buddhists from the *Γυμνοσοφισταί*, or naked sages, and though other writers confound them, that will not excite much surprise in the mind of any one who knows what crude notions on many Indian subjects, after so long and close an intercourse, still prevail in England.

The only persons at all within the pale of Hinduism who adopt the practice of going about naked are a set of Kaplánska Gosáns, extreme votaries of Siva, who are considered as schismatics by the Bráhmans, and who are confined to the east and south of India, and unknown in the west, where the Greeks came in contact with the Hindus. Their origin, too, cannot be traced back by either tradition or ancient documentary evidence to the times of the Greek intercourse with Western India, while that of the Jains can, by traditions and writings as worthy of credit as any that exist in the country.

As, then, both Bráhmans and Buddhists, not only by their present practice, but in all their extant writings, condemn the practice of sages going about unclothed, as there is not the least evidence of any such usage having ever prevailed among either the one party or the other ; as the Jains have in their sacred books laid down the want of clothing as the characteristic of their first and last deified religious legislators, and as a set of Digambars has continued to exist among them from of old to the present day, the only conclusion that is left to us is, that the Gymnosophists whom the Greeks found in Western India, where Digambarism at present prevails, were Jains, and neither Bráhmans nor Buddhists ; and that it was a company of Digambars of this sect that Alexander fell in with near Taxiles, one of whom, Calanas, followed him to Persia.

* *Manu*, book iii. 168—172; v. 22, 41.

ART. II.—*Buddhist Antiquities in China.* By the Rev. J. STEVENSON, D.D., President.

Presented September 15th 1853.

IN Fortune's *Tea Districts of China and India* there is an account of a curious Buddhist Inscription (plate vi.) in an island near Chusan, of which, not having yet seen any explanation, I beg to submit a translation, with remarks, to the Society.

The passage in question is as follows :—“ After staying a few days at Chusan, I went onward to another of the islands, named Poo-too. This is commonly called by foreigners the ‘Worshipping Island,’ and is inhabited by the priests of Buddha, and their followers. I had two objects in visiting it at this time : the first was on account of my health, which was getting affected by the excessive heat of the weather ; and the second was to obtain a copy of some inscriptions which I had observed on a former occasion. When I landed, I walked over the hill in the direction of one of the principal temples, which had been built in a little valley or glen between the hills on the road-side. By the way, I came to the stones on which the inscriptions had been carved. There were two of them : they looked like little grave stones, and, as usual in such cases, each had a small place near its base for burning incense.

“ The characters upon them were not Chinese, and no Chinaman could read them. I applied to some of the most learned priests in Poo-too, but without success. They could neither read them, nor could they give me the slightest information as to how they came to be placed there.

“ The characters looked like those of some of the Northern Indian languages ; one of the stones was evidently less aged than the other. In this the unknown character was placed along the top, and a row of Chinese ones below. The latter, when read, appeared to be nothing more than an unmeaning phrase, used by the Buddhist priests at the commencement of their worship—*Nae Mo o me to ga* : what the upper line means some oriental scholar may possibly be able to say.

"The second stone was evidently very ancient. There were no Chinese characters upon this. How or when these stones were placed there, it is difficult even to form a conjecture. Buddhism we know was imported from India to China, and it is just possible that under these old stones may be the remains of some of its earliest teachers."

To any one acquainted with the Tibetan alphabet, it is easy at once to pronounce the foreign character in these inscriptions to be the Tibetan. In Devanagari and Roman letters the second and principal of them may be read as follows :—

त्रम	Blam.
ओं । अरकचन । ह्रीः	Om.—Arakachana Hríh.
ओं । मणिपद्मे । हां	Om.—Manipadme Hám.
ओं । वज्र-पाणि । हुः	Om.—Vajrapani Huṇh.

The first inscription is nothing more than the second line of this, with a Chinese gloss below.

The general character of these inscriptions, too, is sufficiently obvious: they are Buddhist formulæ, held in great reverence by the people, especially in Tibet, where the second of them is written frequently on temples and other public buildings, and held in something of the same esteem as the Bráhmans hold their Gayatri, with this difference, that instead of seeking to conceal it, they, in accordance with the general spirit of their religion, seek to publish it. The Nepálse, however, think this wrong, and in this, as in many other things, have taken their ideas from the Bráhmans.

This formula has exercised the ingenuity and learning of Klaproth, Hodgson, and Mill; and were it not that the accompanying formulæ, as I think, throw additional light on it and the whole subject, I might be spared any remarks upon it.

The whole of the formulæ then, I think, belong originally to the Hindú Tantra, though they are capable also of receiving an Orthodox Hindú, a mystical, and a popular Buddhist interpretation.

In a Tāutrika tract, the नवार्णन्यास (*Navārnanyāsa*), which I have now before me, I find ह्री very frequently used, and among other symbols also हुँ and हूँ. I asked a Bráhman to write down the Hindú symbol corresponding to those in our inscription, and he gave me ह्री, हां and हुँ: The correspondence of these with those in our inscriptions is striking, and plainly points to the source whence these sacred symbols of the Buddhists was originally derived. In the last of the Tibetan

formulæ it will be observed that the nasal mark is combined with the visarg, a combination that neither in the ancient Vedic nor modern Purânic Sanscrit can occur. It is a peculiarity of the Tantrika mantras. That this is no casual reading will appear from Klaproth's fac-similes, three of which are the same as ours, though he gives no explanation of the visarg, but assumes the word to be the Sanscrit तुम्, meaning *verily, amen.*

The original sense, then, of these Tantrika symbols at the end of each of the lines, would be expressed according to the left-handed scheme by अद्वालय, सैशून, सणि ; in the right-handed system by Sakti, Ganesa, and Siva ; according to mystical Buddhism by Adi Pradnyâ, Sanga, and Buddha ; or the Isis, Horus, and Osiris of the ancient Egyptians, which we might interpret Nature, the World, and God, with some accommodation of the terms to our modes of thinking, as those acquainted with Hindûism will easily perceive. All these Tantrika symbols are to be considered as nouns in the vocative, or interjections, having no variation on account of case.

It is only necessary to notice in passing, that the initial ओ is the popular Hindû symbol for Brâhma, Vishnu, and Siva ; the Buddhist for Buddha, Dhâma, and Sanga ; and the philosophic for the eternal unmanifested essence of deity, from which all else is supposed to have sprung, and which they denominate Omkâra or Brâhma.

In explaining the words in the body of each of these formulæ, we commence with the middle one, as it is by far the most common and important, and the one that is repeated on a separate stone with the Chinese below it.

It is Manipadme, " Oh jewel and lotus !" words which, again, every party may explain according to his own peculiar system. The term is, I conceive, a compound, and in the vocative case, and probably in the dual number, though this is not quite essential ; but the last member must be considered feminine. From the original Tantra, again, we easily get the explanation of Siva and Sakti in India, given by Klaproth, and by parity of reasoning, Vishnu and Lâkshmi, and Adi Buddha, and Adi Pradnyâ ; and not improbably, in the mystical system, the compounding of the two words may be taken to signify Sanga, which means union. According to Hodgson and Klaproth, in the popular Buddhist system of Nepâl and Tibet, this formula is applied to the Bodhi-satwa Padma Panî, who is supposed at present to preside over and regulate the affairs of the world. It is this that probably has given rise to the common but incorrect reading मणिपद्म, since Padma Panî is looked on as a male, and not as a female. To consider मणिपद्म

a locative, and take ~~ते~~ into the construction, or to supply between the two words a copulative, seems to me inadmissible.

In reference to the first formula, अरकचना, I am left entirely to conjecture: according to the radical meaning of the words, it may mean "Oh Enlightener of the age!" and be applied to the same Bodhi-satwa as the last in the popular system, or to the first Dhyāni Buddha, whose name, Vairochana, means nearly the same thing. The last form contains the name of the third Bodhi-satwa in the Nepāl Buddhist cosmogony, and may be applied to him. The vocative here is rather according to the Páli than the Sanscrit usage.

I confess, however, that I suppose our tablet refers to an earlier state of Northern Buddhism than that exhibited in Hodgson's works, in which the system is pourtrayed as it now exists, after having been greatly modified by the influence of Bráhmanism. At the time of the first introduction of Buddhism into Tibet, the triad system was popular in India, as we see from the caves of Elephanta and Ellora, and it was this system I conceive that was first carried beyond the Himalayas and adapted to Buddhism. The Hindú Quintain of Siva, Vishnu, Surya, Lákshmi, and Bhaváni, did not arise till afterwards, and it is this which seems to me to have given rise to the five Dhyāni Buddhas. "Arakachana," I suppose, then, to refer to the Creator in the Hindú sense of his manifesting or bringing the world to light; "Manipadme" I consider to be the preserving and generative power, and "Vajrapani," literally he who is armed with the thunderbolt, to refer to the destructive power of the Deity, understood, either generally in reference to the desolation of the present world, or individually as destroying those bonds of wordly desire which prevent the emancipation of the spirit. In the absence of authority, however consistent this explanation may be with eastern modes of thinking, it might seem unsafe positively to affirm that this is the true interpretation of these symbols; yet I think it sufficiently probable to form on it the translation I have given below.

I have said nothing of the pure Tibetan word at the head of the tablet translated by Csoma de Koros, a superior, or high priest, as it evidently refers to the high repute in which the pray was held.

TRANSLATION.

The Chief of Prayers.

O Triad! O Bringer of the World to light! O Nature!

O Triad! O Efficient and Material Generative Cause! O Universe!

O Triad! O Armed for the World's Destruction! O God!

In endeavouring to ascertain when this inscription was executed, we are not helped by any date contained in it, and are left, therefore, to conjecture.

As the Buddhist religion was only introduced into Tibet about the seventh century of our era, after it had begun to decline, and had been considerably corrupted in India, we must look for some period posterior to this in fixing the date of a Tibetan tablet in China; and as we learn from Desguignes that between A. D. 763 and A. D. 842 the Tibetans were powerful on the northern frontier, and had possession of some parts of the country, it was likely during that period that a small colony of priests penetrated to the island in question, and there established the worship of Buddha, and executed the inscription which Mr. Fortune has copied.*

* Desguignes, vol. i. p. 1 ; article Tibet, p. 165.

ART. III.—*An Account of the Ancient and Ruined City of Brahminabad, in Sind.* By A. F. BELLASIS, Esq. [With a Plan.]

Read April, 1854.

BRAHMINABAD, or Bumbra-ke-Thool,* its more modern and Sindee name, is an ancient and ruined city, situated on the dry bed of a large river, said to have been one of the old courses of the Indus. It lies in an easterly direction about eight miles from the town of Shahdadpoor, and about twenty-one from Halla. It is about sixty miles NE. of the city of Hydrabad, and about twenty miles from the right bank of the Eastern Narra.

Brahminabad in its palmy days has been a large and fortified city, built entirely of baked bricks. Its present appearance is one vast mass of ruins, forming irregular mounds, varying in size according to the size of the original houses, of which these ruins are the humbler representatives. Some idea may be formed of the extent of Brahminabad, when I state its circumference is within a few yards of four miles, measured by a perambulator. Besides Brahminabad, at a distance of about a mile and a half is the distinct and ruined city of Dolora, the residence of its last King, and five miles in another direction is the ruined city of Depur, the residence of his Prime Minister (Wuzeer); and between these cities are the ruins of suburbs extending for miles far and wide into the open country.

Brahminabad appears to have been the commercial city, where the merchants and traders lived; Dolora, where the King and his Court resided, in luxury and pleasure; and Depur, where the Prime Minister transacted, with his officers, the affairs of State. The city of Brahminabad is entirely surrounded with a rampart, mounted with numerous turrets and bastions.

On first entering Brahminabad, so extensive and so complete are its ruins, you feel lost in contemplating its utter desolation; and it takes

* Bumbra, a name frequently applied to old ruined cities in Sind. Thool, a tower, bastion.

some time before the eye becomes accustomed to the confusion and disorder that characterise the place. After a little examination, the most prominent object that presents itself is the ruin of a high tower of brick-work standing isolated on a large heap of ruins, clearly indicating its former extent and importance. This may have been the citadel, or one of those circular towers, such as are seen in Sind to this day in the forts of Hydrabad and Omercote.

Amid the chaos of ruins you may further observe several open spaces or squares, evidently the bazars and market-places of the city : some of these are of great extent, running through the fort. A little imagination and you might picture to yourself that here were barracks for troops ; that in this open space they were wont to hold their parades ; that this was the exchange of the money-lenders ; this the river gate of the city, where customs were levied. Again, it were easy to imagine the noble Indus gliding in a mighty stream past the city walls, her waters studded, as at present, with many a boat, and many a quaint cut sail, and many a Pulla fisherman giving perspective to the landscape. It were easier still to picture along the banks of the river, and immediately under the city walls, the busy haunts of trade : here you might say with certainty were the native craft moored to the bank ; here piles of goods and merchandize were often heaped ; and there, too, you might safely say were crowds of noisy, money-making Hindoos, chattering, bartering, and wrangling after the most approved fashion of modern times. Turning from the contemplation of what may have been to the chaos of surrounding ruins, the only memorials of the past, one is led to inquire what could have caused the utter destruction of a city so large and so strong.

Very little is known of the history of Brahminabad, except what tradition tells : as usual, it is mixed up with fable ; but, wanting records, even fable has its value. The popular account of Brahminabad, as far as I have been able to procure it, is as follows :—

That about seven or eight centuries ago, Brahminabad was a rich and flourishing city. That in those days a very wicked King, named Dolora, reigned in those parts ; and among his many iniquities he made a law that all young maidens, who married any of his subjects, were to pass the wedding night in his palace. The breach of this law was death. Now a certain rich noble had a daughter, beautiful and fair, and she was about to be married. But this law was an insuperable obstacle to the father's wishes. In his difficulties, he went for assistance to a priest of great sanctity, who was supposed to have the power of communicating with both Heaven and Hell, and asked for advice. The priest told

the rich man that he could only devise one way of helping him, and that was by destroying the whole city of Brahminabad, if King Dolora did not by a certain day abrogate this iniquitous law. The rich man besought the priest very earnestly to save the city : he offered him jewels, and silver and gold, to devise some other means ; but the priest was firm, and said he had looked well into futurity, and that there was no other remedy. Then, said the rich man, save my daughter's honour, should even Brahminabad be ruined. Accordingly, there went forth a prophecy, proclaiming to all the inhabitants, that if by a certain day King Dolora did not abrogate this wicked law, Brahminabad would be utterly destroyed, and warning all faithful people to flee the city before the impending calamity came to pass. The King took no heed, and continued in his wicked ways, living in pleasure and luxury in the midst of his lascivious Court. The day came, and with it a most awful tempest, followed by a violent earthquake. The city of Brahminabnd was laid low in ruins, and in its fall, King, courtiers, and unbelievers were buried.

Those who had believed the prophecy of the priest, and had made their escape from the city before this calamity took place, are said to have wandered about Sind for a whole year, seeking for a spot whereon they might settle and build them another city. They searched in vain for a site as beautiful as that of their ruined Brahminabad ; for lands as fertile and rich, for trade as great and flourishing. At last they came to Nussurpoor,* and that being the best place they had seen since they had left their own beautiful city, they settled there, and built them another brick city, and there they dwelt. This too has disappeared, and Nussurpoor is now a mud-built town, like all the rest of the towns in Sind ; but the remains of the old brick city are to be seen to this day. Such is the legend of Brahminabad and its inhabitants.

I have consulted Syud Sabir Ali Shah, a learned Syud of Tatta, and have referred to the few Sindee books that give any account of Brahminabad, and from these authorities I gain the following particulars :—

The Syud states that the city appears to have been founded before the Hindoo dynasty of the Brahmins, which commenced in the first year of the Hijree, or A. D. 622. He says it is mentioned in the Teohfut-ool-Kiram that Chuch, the first of the Brahmin Kings who ruled in Sind, appointed his younger brother Chunder as his viceroy

* Nussurpoor is a city of acknowledged antiquity, and, like Brahminabad, situated on the banks of one of the old branches of the Indus. It is still a place of some repute and learning, and has a not inconsiderable trade.

at Alore, and employed himself in arranging the boundaries of his kingdom, having subdued Mah, the Chief of Sehwan, and Agheer, the Chief of Brahminabad. From this the Syud infers that the city was probably founded during the reign of the Rajahs before the Brahmin dynasty.

The Syud also states that the city must have been ruined before the expiration of the fourth Hijree century, or about A. D. 1020, as he finds it mentioned in the Toohfut-ool-Kiram, in the narration of the Soomras, that Chota Amranee, brother of Dolora Amranee, departed to Bagdad on account of his brother's injustice. This Chota Amranee embraced Islamism, and married the daughter of a celebrated Arab, whom he brought to Sind in the fourth century, together with a number of Arabs, who, in company with Syud Ali Moosooee, had been made over to him by the Khalif of Bagdad.

The Chuchnama contains a History of Chuch, the first of the Brahmin Kings of Sind, and of his dominions. It was written in the original Arabic, about A. D. 700. Therein is mentioned of Brahminabad as the chief city of one of the divisions of the Kingdom of Cyrus bin Saheeraee, who lived before the time of Mahomed. It also contains an account of the battles fought there, but mentions neither the date of its foundation nor its destruction.

The Toohfut-ool-Kiram contains a comprehensive general history of Sind, and was written about ninety years ago (A. H. 1180), and is a modern work in comparison with the Chuchnama.

The Chuchnama was written by Ali Koofee, who came to Sind with the army of Mahomed Kassim, sent in A. D. 710 by the Khalif Wulleed, son of Abdool Mullik of Bagdad. Mahomed Kassim defeated Dahir the son of Chuch, conquered Sind, and overthrew the Brahmin dynasty of kings in 711 A. D.

It was on the 11th of March 1854 that I, in company with Mr. C. M. Richardson, visited the ruins of Brahminabad.

A few officers had previously visited, at different times, these ruins, and had collected some coins and other curiosities, which are readily found on the surface, and many others had been obtained from villagers, who are in the habit of digging in the ruins for bricks, and thus find a variety of beads, stones, and coins; but no person had ever attempted systematically to excavate. Mr. Richardson and I were therefore resolved to devote two or three days to Brahminabad, and to endeavour, by carefully removing one of the heaps of rubbish, to disclose any remnants of a house that might have been concealed therein for centuries.

We selected for excavation a heap of ruins standing on the verge of

the principal bazar or square. We had not commenced many minutes before we came upon the edge of a wall : clearing it, we soon came upon a cross wall, and then upon another, and another, until a house with a variety of rooms began fast to take shape, and disclose its proportions. We had not dug two feet before we came to quantities of bones, and at that, and greater depths, skeletons were so numerous that it was hardly possible to dig a powra* full of earth without bringing up particles of bones. As far as I could judge, many were undeniably human bones, and others those of cattle and of horses. The human bones were chiefly found in doorways, as if the people had been attempting to escape, and others in the corners of the rooms. Many of the skeletons were in a sufficiently perfect state to show the position the body had assumed ; some were upright, some recumbent, with their faces down, and some crouched in a sitting posture. One in particular, I remember, finding in a doorway : the man had evidently been rushing out of his house, when a mass of brick-work had, in its fall, crushed him to the ground, and there his bones were lying extended full length, and the face downwards. These bones, on exposure to the atmosphere, mostly crumbled to dust, and it was very difficult to obtain anything but fragments. But in excavating, you often obtain a good section of the skeleton, and thereby can easily tell the position of the body.

Besides bones, I found large quantities of pottery in great varieties, and much of it of a very superior description to any I see now-a-days in Sind. A good deal of the pottery was glazed in colours, of great brilliancy, and some of the vessels are of a fine kind of earthenware or china. Pieces of glass and crystal were also found, both in the excavations and on the surface of the ruins, in quantities, and the glass of all kinds of colours. Fragments of cups, bottles, and platters were very numerous. Some of the glass was beautifully stained of a deep blue colour, and other portions were worked in raised and ribbed patterns, displaying a high standard of art in their manufacture. Stones for grinding grain ; others for grinding curry-stuff, and some for mixing paints ; several stones for sharpening knives and tools ; several large pieces of korundum or emery, also used by cutlers to sharpen swords and instruments ; quantities of cornelians and cornelian chips, agates, and other pretty stones ; balls, beautifully turned, of ivory, agate, and marble ; coins, chiefly of copper, some few of silver ; beads and ornaments of cornelian and glass, in every variety. In one of the rooms I found a large grain jar, ribbed in circles ; its mouth was arched over with brick-work.

* The powra is a large hoe, in general use in Sind for digging, but a very bad instrument for excavating ruins, as it is very liable to break anything found.

I at first took it for a well, but afterwards discovered it to be a sunken grain jar. The diameter of its mouth was two feet, and inside it was empty for four feet, the bottom portion being filled with mould, possibly the decomposed remains of the grain.

The city must have been famed, like the present cities of Ahmedabad, and Cambay in Guzerat, for its works in cornelians and agates ; and it is probable that it was from that province that a trade was carried on for these stones. There are no cornelians of the kind found indigenous in the alluvial plain around Brahminabad, and the mines of Kupperwunj in Guzerat are probably the nearest place from which they could have been imported. From the quantity of cornelians, chips, &c., besides grinding and sharpening stones, found in the excavations, I am led to conclude that the house excavated must have been inhabited by a lapidary.

Among the copper coins are many of liliputian size,—so small that their value in the present day would hardly be calculable. In a city where such coins were employed in the most ordinary and daily money transactions, how cheap must have been the price of food ?

Among the curiosities⁴ found at Brahminabad, showing an advanced state of art, are some beautiful engravings on cornelians and agate. Many of them are perfect gems of art, and, like the intaglios of Rome, are polished on the inside of the device,—an art, I believe, now lost. Some that were found had upon them a bull, and others a lion ; some merely a name in Arabic, and some in characters resembling the Devanagree or Sanskrit : most of these appeared cut in ovals and circles, and would be well suited for the purpose of a signet ring ; others were ready cut into these shapes, but without any inscription or device, as if the engraver kept an assortment for the choice of his customers, who had only to express their wish—what device, what name—and the hand of the cunning artist was prepared to make any engraving ordered.

I am not aware that lapidaries of the present day are able to produce figures and patterns upon cornelians without making an incision in the stone,—no process of burning, no application of acid, will leave a permanent mark upon a cornelian ; but yet at Brahminabad many of the cornelian ornaments are found figured with various patterns in white lines, on a perfectly smooth surface, and, after having withstood the damp of ages, are, when dug up, quite fresh.

Among the glass discovered, were several pieces in a state of decomposition, some with all the beautiful metallic colours of the soap-bubble, some that had become quite opaque, and other pieces with both sides in the last stages of decay, and only a thin fibre of glass in the centre. To describe the process of decomposition in glass, I cannot do better

than give Sir David Brewster's opinion on similar pieces of ancient glass found by Mr. Layard at Nineveh.*

Finding glass in this decomposed state is testimony of the antiquity of

* *Sir David Brewster's Opinion on the Ancient Glass found at Nineveh.*

"The different kinds of glass in common use consist of sand or silex, combined, by fusion, with earths, or alkalies, or metals, which either act as fluxes, or communicate different colours or different degrees of lustre, or refractive power, to the combination. In quartz, or rock crystal, which is pure silex, and in other regularly crystallised bodies, their molecules or atoms unite in virtue of regular laws, the pole of one atom uniting with the similar pole of another. Such substances, therefore, do not decompose under the ordinary action of the elements. The lens of rock crystal, for example, found by Mr. Layard at Nineveh, is as sound as it was many thousand years ago, when in the form of crystal.

"In the case of glass, however, the silex has been melted and forced into union with other bodies to which it has no natural affinity; and therefore its atoms, which have their poles lying in every possible direction, have a constant tendency to recover their original positions when in the state of silex. For the same reason the earths, or alkalies, or metals, with which the atoms of silex have been constrained, by fusion, to enter into union, all tend to resume their primitive state, and separate themselves from the silex.

"Owing to the manner in which melted glass is cooled and annealed, whether it is made by flushing, or blowing, or moulding, the cohesion of its parts is not the same throughout the mass, and consequently its particles are held together by different degrees of force, varying in relation to points, lines, and surfaces. No atom of the flux or other ingredient may be less firmly united to an atom of silex in one place than in another, depending on the degree of heat by which they were united, or upon the relative position of the crystalline poles of the atoms themselves when combined. There are some remarkable cases where flint glass, without any rude exposure to the elements, has become opaque; and we have seen specimens in which the disintegration of the same kind of glass has commenced a few years after it was made. In general, however, the process of decomposition is very slow, excepting in stables, where the presence of ammonia hastens the decomposition, and produces upon its surface all the beautiful colours of the soap-bubble.

"It is, however, from among the ruins of ancient buildings that glass is found in all the stages of disintegration; and there is, perhaps, no material body that ceases to exist with so much grace and beauty when it surrenders itself to time, and not to disease. In damp localities, where acids and alkalies prevail on the soil, the glass rots, as it were, by a process which it is difficult to study. It may be broken between the fingers of an infant, and in this state we generally find in the middle of it a fragment or thin fibre of the original glass which has not yielded to the process of decay.

"In dry localities, where Roman, Greek, and Assyrian glass has been found, the process of decomposition is exceedingly interesting, and its results singularly beautiful. At one or more points in the surface of the glass the decomposition begins. It extends round that point in a spherical surface, so that the first film is a minute hemispherical one of exceeding thinness. Film after film is formed in a similar manner, till perhaps twenty or thirty are crowded into the tenth of an inch. They now resemble the section of a pearl, or of an onion; and, as the films are still

Brahminabad : if other evidence be wanting, we have it in the decomposed state of the bones. These bones I have shown to several medical men, and they are all agreed that they are of great antiquity. Dr. Beatty in particular, when he examined a skull and several other bones, told me that he did not recollect to have seen bones in any museum apparently of such great age ; that all animal matter in the cellular cavities of the bones was completely exhausted, and that such a process of decay would take centuries of time so completely to effect. *

I am aware that in certain soils the decomposition of bone is very rapid : thus in graveyards, where the soil is wet and clayey, instances are not uncommon that after a body had been buried forty or fifty years, not a vestige of a bone could be discovered, so complete and rapid had been the process of decay ; but in soil like that of Brahminabad, dry alluvial sand, upon which rain rarely falls, I presume decomposition would be very gradual.

Of the bones found, many were unquestionably human, others the bones of camels, horses, oxen, dogs, and fowls. In one of the rooms excavated, among a number of bones, we came upon a quantity of stuff that looked very like ashes, but which I believe to be the remains of smaller bones, whether of men or animals, reduced to dust. A bushel of it might have been collected, and there are two bottles full of it among my collection from Brahminabad. Many of the teeth found are curious, and show the signs of great antiquity : the enamel on some is pretty perfect, but is very liable to peel off with the slightest pressure.

A variety of women's bangles or bracelets were also found ; some of glass, others of brass and copper, and a number of ivory, worked over in patterns.

Among the collection are two round solid balls of pottery, the use of which it is difficult to imagine. The most probable supposition is that they were used as missiles, and may have been employed by the defenders of the city against an invading force.

The most curious relic* I found was a hexagonal cylinder, of what I guess, were brilliant colours of thin plates when we look down through their edges, which form the surface of the glass ; these thin edges, however, being exposed to the elements decomposed.—*Layard's Nineveh and Babylon.*

* Another curious relic of antiquity, which I have very recently received from Brahminabad, is a brazen horse, with a rider thereon. It is caparisoned with a bridle, martingale, and a necklace ornament. It has no saddle, nor saddle-cloth, and its rider rises centaur-like out of the back of the horse. The horse stands about $5\frac{1}{2}$ inches high, but I regret to say the head and shoulders of the rider have been broken off. I also found a small brazen bull, worn probably as a charm, half an inch in height.

imagine to be wood, or perhaps ivory, with an inscription in Arabic in cufic characters on each side. It is three inches in length, and two and three quarters in circumference. It was probably a talisman or charm, which, when wrapped up in silk or leather, was worn round the arm or neck. It was unfortunately fractured soon after it was discovered, and has been put together with glue by Mr. Richardson. The Arabic inscriptions, as far as they were legible, are "Allah is merciful," &c.

Finding such success during the first day's excavation, I increased the number of excavators from twenty to seventy, and in the three days I was at Brahminabad I excavated three distinct houses, two on one side, one on the other side of a street fronting the principal bazar. A ground-plan of the excavation is given: it has no pretensions to great accuracy, but is generally correct;—many of the measurements were taken under a burning sun in the month of March, and others by torch-light. I also give a rough sketch of the front elevation of two of the houses. In reference to the ground-plan, it may be observed that there are several of the rooms without any door or entrance. This can only explain by stating that some of the walls were found four, five, and six feet in height, and above the steps of the doorways, while others were found only a few inches above their foundation, and consequently below the doorways.

Again, it might appear strange, to a person not acquainted with Hindoo habits and customs, to find the bones of camels and cattle inside a house; but those who have lived in India will in that fact immediately recognise a custom to be seen in every Hindoo or Mussulman city of the present day.

"The walls of the excavated houses," says Mr. Richardson, in his notes on Brahminabad, "are well and substantially built,—here again showing the superiority of the men of old to those of the present day. The walls are all true, and at right angles to each other, as if built with the plumb and line, and not running in and out, without regard to symmetry, as we see buildings now-a-days in Sind. The walls are from a foot and a half to three feet thick, and no chunam or lime is used in their construction,—nothing but common mud; the floors appear to have been tiled, and the whole building built upon a raised platform, about six or eight feet above the common level. Small as these remains are, they are quite enough to show that the city was well and substantially built;—so much so that I am convinced that nothing but the hand of God could have caused such an overthrow. The ruin of ancient Babylon is not more complete."

I was at first of ~~the opinion that~~ Brahminabad had been destroyed by an invading army, who had pillaged the city and slain the inhabitants, and

that time and decay had made it a heap of ruins. Old Buddeena, in Lower Sind, is an instance of this kind : there you see heaps of ruins not unlike those of Brahminabad, but in the midst of the ruins you also see several buildings, such as mosques and temples, whose walls were too strong for the hand of man to overthrow, and upon whose strength time and slow decay alone make any impression. At Brahminabad the ruin of the city seems to have been complete, and, with the exception of the fragment of the tower before described, nothing appears to have escaped utter destruction. This fact, added to the number of persons whose bones were found inside the houses, together with the quantities of coins and valuables that are to this day in Brahminabad, shook my belief that an invading army had destroyed the city.

Nor do I believe that the city was destroyed by fire. The walls had not the appearance of a conflagration. The many delicate articles everywhere to be found in Brahminabad, in a general conflagration of the city, must have been consumed : the glass, for instance, would have been fused ; the bones would not have been in existence ; and the delicate ornaments of the women would all have been destroyed, or borne the marks of fire ; whereas nothing of the kind is discernible. The marks of fire were alone found on a few cooking-pots, and charcoal was also discovered near the flooring of the rooms, not in any great quantity, but as much as it might be expected the occupants of such houses would be likely to have for cooking purposes. The charcoal was as fresh as if made yesterday.

Mr. Richardson on this point observes :—“ We found no remains of wood, which might have been used in the construction of the buildings ; and, save on the floors, and there only in small quantities, no charcoal, or remains of burnt wood ; so we may fairly conclude the city was not burnt. Neither do the old walls we have excavated bear the evidence of having been under the action of fire. A few old iron nails were found, but quite decomposed, retaining nothing but the form of a large spike nail. The almost entire absence of chunam seems strange, it being so generally largely used by Natives in the construction of their more substantial buildings. There is, however, no limestone to be found within forty miles of the place, and this may account for the want of it.”

Under all these circumstances, I think it highly probable that the popular account that Brahminabad was destroyed by an earthquake is true. It must have been some such convulsion of nature to have effected the complete and utter destruction of a city so strongly built as Brahminabad ; and I further think it probable that the same convulsion that

shook the city to its very foundation changed the course of the river which once without doubt washed the city walls.

Mr. Richardson gives three good reasons for supposing the city to have been destroyed by an earthquake,—they quite coincide with the opinion I have given above; but as Mr. Richardson is a very keen observer, and as his account is graphically expressed, I give it without fear of tiring my reader with a repetition. He says “That the city was destroyed by some terrible convulsion of nature is, I think, sufficiently evident,—

“1st.—Because the destruction is too complete to have been the work of time. A place so substantially built would in all probability have had some few buildings in a tolerable state of preservation ; and also from the human remains found in one of the buildings which were excavated. These remains were found in the corners of the rooms. The wretched, terror-stricken inhabitants, finding their houses falling about them, like any other animal, crouched in the corner, and the falling material buried them. These remains (merely bones) were in a very decomposed state, —so soft as to be easily crushed to dust in the fingers ; we were not able to get any entire bones. It is not probable these bodies were regularly buried in the places we found them : had they been so, the remains in all probability would have been found in a recumbent position, and not all crushed in a heap, as they appear now. I picked out one brick which entered corner-ways into a skull, and which, when taken out, had a portion of the bone adhering to it, but it was so fragile that I fear it cannot be preserved.

“2nd.—Had the city been destroyed by an invading army, the destruction would hardly have been so complete : had twenty barrels of powder been placed under each individual building, the ruin could hardly have been more perfect ; besides, whatever mischief the soldiery of a conquering army might have committed on buildings and other property, they would surely have carried off coins and other valuables, which are now found in infinite numbers on the surface, but, generally speaking, so decomposed, from exposure to the elements, that the legends are obliterated. However, a careful and diligent search might be successful in procuring more perfect specimens than those yet seen, and might throw some light on the history of the city, &c. &c.

“3rd.—Had the city been regularly deserted, the inhabitants would surely have carried their valuables with them,—money in particular, and ornaments. The place must have been inhabited chiefly by Hindoos, as its old name, Brahminabad, would imply ; and unless the Hindoos of former days were a very different people from the present race, and

supposing they had had time and opportunity, they would have carried off all their property, even to the last pie."

I do not think that any objection to the supposition that Brahminabad was destroyed by an earthquake can be founded on the fact that a large portion of the tower has remained standing so long after the city itself had been deserted. It may owe its partial preservation to its superior size and solidity, and the fragment which has been standing within the memory of the present inhabitants is evidently but a very small portion of the original edifice.

In the time of the Kaloras, so much remained that the reigning prince ordered the demolition of the steps leading to the top, for the purpose of frustrating the designs of robbers, who used the tower as a place of observation, from which to watch travellers as a preliminary to plundering them. A large portion of the tower, without the steps, was standing till about thirty-five years ago, when it fell, and has since remained in much the same state as it is now—a mere fragment.

Besides Brahminabad, there are the remains of several other cities on or near the supposed ancient course of the river Indus, showing that when that stream flowed by Omercote into the Gulf of Kutch, this older valley of the Indus was a fertile and populous country.

There is the ancient city of Alore, near Roree. Of his Highness Meer Ali Moorad's territory, which next intervenes, little is known; but directly you re-enter British territory, the remains of antiquities again appear. Lieutenant Jameson in a recent letter writes,—“I paid a visit to an ancient city in the Nowshera Purgunna, but there was nothing to discover. Ruins there are none, and the only thing that betrays former civilization is the vast quantity of old bricks with which the ground is strewed in every direction. There are one or two other places in the Mora Purgunna (immediately south of Nowshera), and from their uniform appearance and situation they must have formed a line of cities, or towns on or near the banks of the Indus in a former dynasty, when the course of the river lay near them.”

South, again, of these localities is Brahminabad, and further south, between Kippur and Omercote; I have heard of other ruins, and the remains of cities, and again, near the borders of the Runn of Kutch, are the ruins of Old Buddeena. Besides these there may be others, as this part of the country is little known.*

Another striking feature in this valley is, that along its whole length

* The ruins of Shahkapoor, in the Shahbunder district, are midway between Buddeena and the present course of the Indus, and on a branch of the Pinyaree rather than of the Narra. Lieutenant Phillips' account of Shahkapoor was forwarded to the Bombay Branch of the Royal Asiatic Society in May 1853.

Inscriptions.

on the octagonal Talisman in old Cufic.

اللَّهُ وَعَلَيْهِ لَوْغَرَمْ هُوَ وَاحِدٌ

(God and Ali, if they wish any thing, it is the same as an

لَا هُوَ الْعَلِيَّ إِلَّا وَهُوَ عَظِيمٌ بِاللَّهِ

Ali is not, but by the aid of God, he becomes great.

مَا يَحْفَظُ بِاللَّهِ وَكَبِيرٌ حَقًا كَمَا يُوْجَدُ

ever is protested by God, a greater than that in truth canno
be found.

بِأَيْدِيِ اللَّهِ وَنَحَا بِأَمْرِ طَارِيْرِ بَجَدٍ

By the assistance of God, rest of the line not understood,

اللَّهُ مَلِكٌ وَعَلَيْهِ فَلَأَلَّهِ إِلَّا اللَّهُ أَجَبَّاْنِ

is the King and Ali is (---) there is no God but the Lord is
powerful

لَهُمَا الْكَلَامُ الْمَغْفِرَ الْأَمْرُ مَا هَنَا

ion is the (---) word as a boast (and there is none) excep

ended are also the inscriptions which have been deciphered
from some of the Seals and Coins.

Inscriptions on the Seals.

يَا خَدَا يَا مَالِكَ يَا حَافِظَ

Oh God! Oh Master! Oh Protector!

امام باقر

Imaum Bakur - a proper name.

पाराणा.

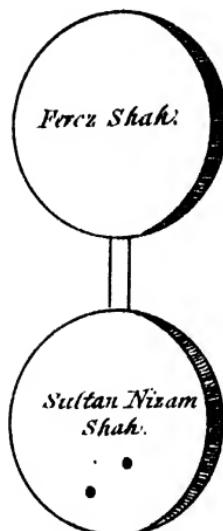
Vanrana or ja rana - King

"Her inscription" supposed to be Arabic but unintelligible

are several other inscriptions in characters which I

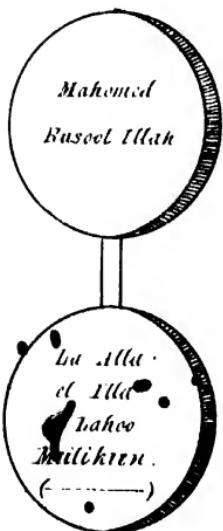
Inscriptions on the Coins.

فیروز شاہ



سلطان نظام شاہ

Mahomed the
Prophet of God.
محمد رسول الله



*There is no God,
but the Lord, and
there is no Master
to him.*

لَا إِلَهَ إِلَّا اللَّهُ لَا هُوَ مُلْكٌ

you can trace the dry bed of a large river. The main stream I take to have been the Eastern Narra,* which, flowing past Omereote and through Kutch, found an outlet into the Gulf of Kutch, or perhaps at Lukput, and in more modern times lost itself in that vast lagoon the Runn. This main stream threw off in its course several branches, the Dhoras or Poorans, the dry beds of which are clearly defined traversing the country fifteen to twenty miles west of the main stream, but parallel to it.

Lieutenant Lambert, writing from Mehrab-ke-Gote, near Wunga-ke-Bazar, on the borders of the Runn of Kutch, says: "I have just seen the Pooran; it is a splendid clear river bed, as large and distinct, and nearly as deep, as the Fullailee, and the country about contains the finest land, all waste. There is in its bed, where I have just been, a large pool about one hundred yards across each way, which is always filled with water, and contains fish of large size (30 or 40 lbs.), and according to the people here the pool is without bottom. Strange to say, there is no cultivation from it. There is an idea that because the Hindoos hold yearly fairs there it is unlucky to cultivate from it. The sandhills are about six or eight miles beyond, and the Narra runs along the foot of them, and I saw, in the short distance I went along the Pooran, two branches said to communicate with the Narra. I saw the Pooran again above Mora, as clear as here. It has not been traced yet between Mora and Meerpoor, but from Meerpoor downwards to Wunga-ke-Bazar, Lieutenant Pirie has traced it, and it is clear the whole way."

I give these extracts because they throw some light on a very interesting country, of which very little is known, and I trust they may encourage further research in others. There can be little doubt that this valley was broader than the present valley of the Indus, that its soil was even more fertile, and its population, judging from the remains of its ancient cities, more numerous. There is not at the present day a city in Sind which, if overthrown by an earthquake to-morrow, would make such a show of ruins as Brahminabad.

In concluding this paper, I must add that I hope to revisit Brahminabad next cold season, and to continue the excavations, and that I shall be glad of the company of an antiquary, who is inclined to join my camp, and to dig among the ruins of the SIND POME.

* A great public work is now in progress, at an estimated cost of about Rs. 5,00,000, under the superintendence of Lieutenant Fife, of the Bombay Engineers, to restore a permanent stream of water to the Eastern Narra, by cutting a supply channel of nearly eleven miles in length at a little above Roree, so as to connect the Indus with the Narra. This, and other works it is in contemplation to carry out on the Narra, will have the effect of restoring fertility to the whole of this valley, from Roree, past Kippra and Omereote, to Lukput.

**ART. IV.—*Parting Visit to the Sáhyúdri Caves.* By the
Reverend J. STEVENSON, D.D., President.**

Presented 20th April 1854.

IN a journey to and from Ahmednuggur, which I had lately occasion to undertake, I embraced the opportunity of visiting the Caves at Karlen and Junir. The advance of the season, with other circumstances, prevented my including Násik, as I first intended, though there were no very important doubts there to be solved.

The object I had in view was to ascertain how far the lithographed copies of the Cave-Inscriptions, lately published by our Society, were to be depended on; and whether the changes I had ventured in some instances to make were warranted by the originals engraved on the rocks.

After a careful examination and comparison, I may venture to say that Mr. Brett's fac-similes are in general very exact, and that the reduction of them in the Society's Journal is on the whole faithfully executed; so much so, that no one who is acquainted with the Cave Alphabet need experience any difficulty in making a transcript of the letters that remain uninjured, into the Devánágari. As, however, few of the inscriptions are entirely perfect, nearly all having suffered more or less from the ravages of time, it is not an easy task to present them as they originally stood. Cracks in the stones are mistaken for parts of letters, and parts of letters widened by the decay of the rock are apt to be passed over altogether, as mere blemishes in the stone. In many instances, after the copyist has done his best, doubts will still remain; yet, as far as I can judge, Mr. Brett has exercised a just discrimination in most cases of this kind.

There are, however, one or two exceptions to this general eulogy, which must now engage our attention.

In the first Karlen inscription we have the name of a monarch, whose son executed one of the pillars outside the entrance of the Great Cave. According to our lithograph the name of the sovereign in question must be read *Goti*. Depending on other authorities, I read the name *Bhoti*, and for reasons given (page 3 of the July No. of 1853) identified

this sovereign with the Deva-Bhuti of the Puráns. The point to be decided then was, whether the first consonant should be read **प** (*g*) or **व** (*bh*). In the cave character **प** is a semi-circle, with its convexity turned upwards, and **व** is the vertical segment of a bottle whose neck is about three-fourths the length of its body. On examination, then, I found the neck of the letter in question well expressed, and quite distinct, and as long in proportion to the whole letter as that of the **व** in the third syllable from the end, about which all are agreed, though this latter is altogether a larger letter than the former. The reading I adopted, then, is the correct one, and the lithograph requires here to be amended.

In reference to the other parts of this inscription, I would notice that the tail of **त**—the last consonant in *Bhoti*—is too long in the lithographs, and resembles **त**. I was wrong in reading the fifteenth and sixteenth syllables नाक. The word is decidedly नाक, though, as previously noticed, the meaning is the same.

In No. V., marked in the lithograph, by a confusion of figures, No. III., there is a mistake at the beginning of the second line, where the first syllable on the stone is plainly **मि**, as formerly conjectured. I should notice here, also, that No. III. of the text is No. IV. of the lithograph, and, again, No. IV. of the former No. V. of the latter.

In reference to No. X., the conjecture I made regarding its position is incorrect. It is over a blocked-up door, to the left of the entrance of the Great Cave. This door must have led into the space behind the pillars on that side, which in ancient times may have been used as a refectory, though now made into a house, by a rude wall of stone and mud, for Gosains.

No. XV. is on the fifth pillar from the door on the right,—on the spectator's left while entering.

The series of Caves at Karlen are the Great Temple, containing the Dagoba, in which cave and on front of which most of the inscriptions are engraved; two monastery caves to the right, the first of three stories, and containing no inscriptions; a second monastery cave on the same side, of two stories, in the upper part of which is inscription No. XVIII.; and in addition four other small excavations or monkish cells, to the left of the Great Cave, in the furthest of which, fronting the east, there is a short inscription not taken by Mr. Brett, which I read, though with some doubt of the second word, शिव भगवत्पुराक्षित्वा देव धम; and which may be translated, “To the Perfect One. A religious assignation to the Lord (Buddha), by Buddharakshita.”

At Junir, the comparison of the lithographs with the original rock inscriptions was on the whole favourable to their accuracy.

A few remarks, though not on points of first importance, however, may be made.

In No. VII., the transcript of the two last letters into एवि॒ष्ट is wrong.

The lithograph is not good, and even the original is anomalous; but I think it should be read आ॒ष्ट, so as to make the last word आ॒ष्टाष्ट, that is आगत, "come," as I conjectured ought to be the case, though I did not conceive myself warranted to make the change.

In No. XII., the Vigabh or veranda there mentioned is no part of the temple, but a low range of caves to the left of it.

In No. XIX., the transcript of the name of the village should be अहृष्टजे. Some other points of inferior importance I also noticed, which cannot well be explained in words, and therefore I abstain from further remarks.

I examined also the inscription at the top of the Náná Ghát. In reference to it, my conjectures have proved unfortunate. The fourth syllable of the fourth line is not ए, but आ, and the last letter, though broken, was certainly ष, as Colonel Sykes gives it. I rather think that the preceding letter also is ष, and that what appears a part of ष is but a crack in the stone. The name Asoka, then, could not have formed a part of the inscription; and I incline now to think that Sántin must be the proper name of the sovereign who formed the cave; but whether he can be identified under this name with Asoka, or any other sovereign of that period, I cannot determine. The Sánti of the Puráns is too early for us, and I have not been able to ascertain what is the Hindu name of the Sánti of the Jains.

As I may not again have an opportunity of addressing the Society, I embrace the present occasion to express my gratitude to the members for the favourable reception they have given to my papers on Indian antiquities. Without the advantages of the Library of the Society, however; the stimulus afforded by the success of my fellow-labourers in this and in other departments, especially the geological; and the advantage of such a medium of communication with the public as the Society's Journal furnishes, it is not likely that my attention would have been directed to such subjects at all, or, if directed, that I should have been able to persevere in their successful prosecution.

ART. V.—*Notes on Freshwater Infusoria in the Island of
Bombay.*—No. 1, *Organisation.* By H. J. CARTER, Esq.,
Assistant Surgeon H. C. S., Bombay.

Read February, 1856.

It may appear, at first, trifling to engage in the study of beings too small to be viewed by the unassisted eye; but it soon ceases to do so, when we learn that the highest organic developments are made up of such beings; that every organ has its peculiar being, which differs as much in form and functions as the soldiers of different regiments; and, therefore, that to possess a practical knowledge of an animal or vegetable, we should be acquainted with the several kinds of beings of which it is composed, just as much as a general is with the dress and functions of the different soldiers of an army. What should we say of a general who commenced a campaign with no other knowledge of his soldiers than that one group were artillery, another cavalry, a third infantry, &c.; and yet the physician sets out on his campaign against disease with the little army of which his patient's body is composed, equally ignorant of the wants, habits, forms, and functions of the beings peculiar to the different organs, as such a general would be of the peculiar capabilities of the soldiers belonging to his different regiments. A parity of reasoning serves for both cases, and therefore it is plain, that however much we may be inclined to restrict our pursuit of knowledge in this respect with regard to animals and vegetables, it is not our interest to curtail it in the least with regard to man; while, on the other hand, we find that we cannot confine these investigations to man alone, inasmuch as it is impossible to carry them on successfully in man without constant reference to the simplest forms of organic life. Hence it does not appear, as at first, trifling to engage in the study of beings which are too small to be seen by the naked eye; especially when by such a study we may hope to add that knowledge to our present acquaintance with the human frame which will enable the physician to practise his profession with certainty instead of empiricism, and thus

confer on mankind the greatest of all blessings that scientific research can aspire to obtain.

Influenced by these views, I have not hesitated for some time past, when circumstances would admit, to give my attention to the study of the Infusoria and Freshwater Algae of the island of Bombay, which being the same, generally, as those of Europe, have not occupied me much in specific description, while they have left me comparatively uninterrupted in their structural and physiological observation. How much has been gained by the latter the following summary of my "Notes" will show.

I shall commence with the Freshwater Rhizopoda, *Astasia*, and *Euglena*; but before proceeding to remark on them separately, I would premise some observations on the organisation generally of Infusoria, and these will be arranged under the following heads:— 864

Pellicula, or skin.

Diaphane, or transparent moving matter.

Sarcod, or abdominal mucus.

Molecule, or minute grains.

Granules, or large grains.

Digestive Globules, or spherical spaces which enclose the food.

Spherical Cells, or biliary organisms. (?)

Vesicula, or "Contracting Vesicle."

Nucleus.

Ovules, or embryonic cells.

Spermatozoids. (?)

Impregnation.

Development of Ovule.

Pellicula.—This term has been proposed by Mohl for the consolidated surface of material which has no distinct enclosing membrane; * Dujardin, in allusion to the tegumentary covering of *Amœba*, &c. likens it to the film which occurs over "flour-paste or glue allowed to cool in the air"; † and the same view of it will be taken here. It is at first inseparable and undistinguishable from the tissue which lies beneath it, yielding in every way to the form which the latter assumes. As, however, *Amœba* progresses in development, and its activity begins to diminish, the pellicula appears to thicken and harden, although it still retains great tenacity; and thus the expansions of the subjacent tissue

* Mohl on the Structure of Chlorophyll.—Ann. & Mag. Nat. Hist. p. 325, vol. xv.
foot-note.—May 1855.

† Hist. Nat. des Zoophytes Infusoires, p. 29, et seq.

are seen to burst through it in much the same manner as the end of a stream of lead bursts through its pellicle. Finally, when all activity ceases, and the *Amœba* becomes stationary (by fixing itself to some neighbouring object through a pedicular prolongation of the pellicula), a new layer of the latter is formed below the old one, and thus the capsule is formed, and the pellicula replaced on the body of the *Amœba*, until the latter becomes firmly encysted. To what part of the body of the *Amœba* the pedicular process corresponds I am ignorant; but it is interesting to see that in *Euglena*, where a similar process takes place, it is the anterior extremity which is next the pedicle. Many freshwater Rhizopoda secrete a testaceous covering, which increases in size with the animal; but the fleshy part of the body, being for the most part free, is of course still covered with pellicula. The pellicula forms the surface covering of *Astasia* and *Euglena*;* as well as that of all the *holo-* *poly-* *dipo-* and *mono-* ciliated flexible animalcules and zoospores. Here too, probably, the cilia themselves are also covered with it, though secreted by subjacent organs, analogous perhaps to those which secrete the hairs on the bodies of higher animals,—a supposition that would appear ridiculous did we not find such a correspondence between the vital processes of the highest and lowest developments as to induce us to think the one are but a repetition of the other on a smaller scale; that is to say, effected by similar agents, of corresponding minuteness, conducted on the same principle. Taking the view above given of the pellicula, we must regard it as a structureless product, which hardens after secretion. May we not infer that there is a layer below, specially organised for its formation?

Diaphane.—By this name I would designate the moving substance on which the pellicula rests. In *Amœba*, whose primary figure is spherical, it has the power of changing this into an almost unlimited number of secondary forms, most of which, being attended with root-shaped prolongations, justly entitles this infusorium to a place among the Rhizopoda. That the diaphane is structureless and transparent, so far as our microscopic powers extend, may be seen by the travelling of some kinds of *Amœba* across the field of the microscope, in which the coating

* Although *Astasia* and *Euglena* are here mentioned together, it seems that, in classification, one should be on the animal, and the other on the vegetable side of *Amœba*; for *Astasia* possesses a mouth and complicated buccal apparatus for biting off and taking in food, while *Euglena* appears to have no mouth, and to be nourished by endosmosis. The half-developed cilium, too, in *Euglena*, compared with the strong prehensile organ which it is in *Astasia*, with many other points which will be mentioned hereafter, allies the former as much more to the zoospore or gonidium of the Algae, as the reverse does the latter to the higher infusoria.

of the diaphane, though broader all round than the diameter of the turbid mass of contents in the centre, only now and then, when the light is favourable, comes into view. The radii in *Actinophrys* are wholly devoid of turbid material, except towards the base; and the advancing border of the *Amœbae* generally is always transparent. But whether granules are mixed with it or not, the diaphane by itself, that is the contracting material, in the present state of our microscopic powers, must be characterised by transparency and motion, without apparent structure. It has the same appearance and polymorphic power in *Difflugia*, *Euglypha*, and *Arcella*, as in *Amœba*; but in *Astasia* and *Euglena*, though still possessing great latitude in this respect, it can put forth no prolongations, and, consequently, the primary forms of these families are never entirely lost. This latitude is still more limited in *Oxytricha*, *Plæsconia*, *Paramecium*, &c., though in many infusoria of this class it has still the power of temporarily producing considerable alteration in shape. It might be stated that the diaphane cannot be demonstrated in these animalcules; but the great power of motion of their tegumentary covering, combined with transparency, warrants the use of the term here just as much as in *Rhizopoda*, where it is only more striking, because, for want of cilia, the animalcule is compelled to put it forth in delicate expansions and prolongations, in progression, and for the capture of its food; indeed these are the two great modes in which all vital movements are effected.

Some might think, from what has been stated, that there is no difference originally between the pellicula and diaphane, and that the latter passes into the former when the animalcule becomes encysted. But neither appears to be the case; for if we watch *Amœba* or *Euglena* undergoing this process, the activity and accompanying polymorphism of the diaphane is diminished only by the thickening and consolidation of the cyst, until the latter is fully formed, when it ceases altogether. Subsequently, however, in *Euglena*, when this animalcule becomes temporarily encysted, the diaphane separates itself from the last layer of pellicula which completes the cyst, and thus the *Euglena* becomes free within it; after which it will force off the constricted peduncle of attachment from the object to which the cyst may have been fixed, and, projecting its cilium through the broken part, swim about for some time, until (perhaps by increase of size) the cyst is altogether burst, and its liberation restored. Yet it might still be observed, that this is no proof of the cyst and diaphane having been originally distinct structures,—the diaphane may have been re-formed; in which case I can only refer to what I have questioned respecting the origin of the pellicula, and add that

what takes place generally in the higher organisms appears to me to be applicable to the lower ones. Certainly we do not find one structure erected by the organism of another in the former, but the production of each structure dependent on the presence of its proper organism *ab initio*; that is, that the structure does not appear before it is accompanied by the full developed form of the cell or organism which produces it. I do not question that, under the laws of vitality, one organism may occasionally take on the excretory or secreting functions of another, nor that, from a common stock, all organisms, in obedience to the same laws, may be adapted to that which is particularly required of them; but that when once a being is fully developed, each organ of which it may be composed has its peculiar organism, and that organism its peculiar duties, which, except in unusual instances, are the only ones that it is capable of performing. That the diaphane, therefore, should pass into the pellicula, or the pellicula be secreted by the diaphane, seems untenable.

Sarcode.—This name was proposed by Dujardin for the “glutinous substance of the interior” of infusoria,* and we shall here understand it as applicable solely to what, in other words, might be termed the “abdominal mucus.” The sarcode occupies the centre, while the diaphane and pellicula form the circumferential layers of infusoria; besides this, it is the seat of the “granules” and other organs of the interior, and appears to receive the food directly into its substance. From the greater latitude of the particles which are situated towards the centre, that portion may be inferred to be of less density than the rest; and sometimes, when the animaleule is rendered spherical by aqueous distension, there appears to be an actual cavity here; but as I am not certain about the real situation of the water under these circumstances, I shall return to this point again by and by. In the Rhizopoda generally, the sarcode appears to have no external communication, and hence the food must pass into it directly through the diaphane; but in most of the other infusoria it communicates with the surrounding medium by one orifice at least. The same kind of substance occupies a good portion, if not the whole, of the internal or abdominal cavity of *Astasia* and *Euglena*, *Vorticella*, *Paramecium*, and the infusoria of this class. When death is about to take place, it comes forth from *Vorticella*, *Paramecium*, &c., in round, transparent, structureless expansions; and even during life in *Stentor* a portion may be made, by pressure, to issue through a rupture of the pellicula

* *Op. cit.* p. 35.

without any apparent injury to the animalcule.* *Otosoma*,† also, when under pressure, throws off portions of its sarcode through the anal orifice, containing a number of the "spherical cells," to be mentioned hereafter, with which it is charged in this kind of infusorium. As we shall presently find that the portions of food which are received into the midst of the sarcode are circulated round the abdominal cavity, it seems necessary to admit, also, that the sarcode is endowed with a power of motion, in which we cannot help seeing an analogy to that motion which exists in the alimentary canal of higher animals.

In *Euglena* the sarcode is separated from the diaphane by a layer of pointed, sigmoid fibres, arranged parallel to each other, so as to form in *Crumenula texta* (Duj.) a conical cell, which, as soon as the ovules have become developed, and the diaphane and other contents of the sarcode have died off, becomes transparent, but still retains its conical form until the resiliency of the fibres, now unrestrained by the diaphane and other soft parts, dehisce, and the ovules are set at liberty. May we not infer that the siliceous frustule of *Navicula* is similarly situated to this fibrous layer, and that it also derives its power of motion from an external coating of diaphane? That there is a gelatinous layer external to the frustule probably in all *Diatomeæ*, may frequently be seen, although it may not be always endowed with mobility. In a species of *Palmella* like *Glaeocapsa granosa* Kg.‡ which I have had under observation, the transparent external covering ("envelope cell," of Cohn) not only at one period presents an actinophorous form, but also moves about under this condition, bearing the green elliptical cell within (singly, or divided into two or four, &c. as the case may be), whose form depends upon the presence of a more or less firm coat, that corresponds in position and office to the spiral coat in *Euglena* and silicious frustule in *Navicula*, viz. in supporting the contents of the sarcode and chlorophyll-bearing protoplasm, and in sustaining their form in all these organisms respectively. In *Oscillaria (princeps)* Kg. mili too, although, like *Navicula*, the presence of a layer of substance endowed with motion round the cells cannot be seen, yet, when we observe the whole chain of a fragment moving slowly backwards and forwards within its sheath, and even extending beyond it, so as to force out the loosened cells at either end (probably for the formation of new filaments), we can come to no other conclusion, than that I see, than that each cell, which corresponds in office

* Ehrenberg, *ap. Dujard. op. cit.* p. 34, foot-note. It is the same with *Nassula*. Au.

† Ann. & Mag. Nat. Hist. pl. ix. figs. 6—8, vol. xvii.—1856.

‡ *Hæmatococcus granosus*. Hassall, pl. 81, fig. 6. Brit. Freshwater Algae. But with cells scattered, not continuous.

to the frustule in *Navicula*, &c., is surrounded by a transparent, gelatinous substance, endowed with motion, and that, *en masse*, they perform this act. In none of these instances does this envelope, if existing in *Navicula*, as well as the rest, present any change on the addition of iodine but a yellow tinge, even when assisted by sulphuric acid; and it therefore appears to be entitled just as much to the term of diaphane in *Navicula* (if present), *Glaeocapsa granosa*, (?) and *Oscillaria*, as in the infusoria. In *Closterium* there are no signs of an organ of this kind externally, except at the extremities, where it may be an extruded part of the ciliated protoplasm within; for *C. lunula*, as Morren has stated, can fix itself by one end, and partially rotate upon that end; while in *pirogyra* this much extrusion of the protoplasm is not permitted, and the cell is here closed after the manner of vegetable cells generally. What further strengthens the view that there is in some Diatomæc (ex. gr. *Navicula* et *Nitzschia*) a layer corresponding to diaphane on the surface is, that there is some prehensile and transporting organ here, which undoubtedly has the power of seizing particles that come in contact with it, and conveying them partially or wholly backwards and forwards from one extremity of the frustule to the other, or of retaining them on any part of it stationarily.

Molecule.—We will apply this term to the minute, colourless granules with which the sarcode is charged. They differ in size, and are the first bodies that appear in it; but whether they be of different kinds, have any particular office, or undergo any further development, I am at present ignorant. *Amœba*, *Astasia*, and *Euglena*, in the earlier part of their existence, respectively seem to contain nothing else but this molecular sarcode, the nucleus, and contracting vesicle; afterwards the "granules" appear, and last of all the ovules, both of which are developed in the sarcode amongst the moleculeæ. By the time the ovules have become fully formed, the sarcode and its moleculeæ have died off, or disappeared.

Granules.—This name is intended for certain large granules, which make their appearance among the moleculeæ, and are circulated round the abdominal cavity in the manner of the digestive globules and particles of food. They are of different sizes, but chiefly characterised by being much larger than the moleculeæ, few in number, of a circular, elliptical, elongated, sub-round, or irregular shape, with thick dark edges, apparently produced by obstruction to the passage of light,—colourless, or of a yellowish green tint. When large, and with no other granular matters present but the moleculeæ, they form a striking feature in the interior of *Amœba*, *Vorticella*, *Oxytricha*, *Paramecium aurelia*, &c.; but at times

they are so insignificant in size as to be undistinguishable from the moleculeæ, even if present at all. That they are not ovules may be satisfactorily seen when both are together; the dark, thick, and frequently irregular edges and colourless state of the former, contrasting strongly with the thin, circular margin and faint-yellow tint of the latter. They appear to increase in size and number with the age of the infusorium, and, when fully developed, to remain unaltered in size, though apparently somewhat shrivelled in form, until their dissolution. On one occasion, while watching the metamorphosis of an *Oxytricha* (similar to, but not the same as that described by M. Jules Haime,* and of which I hope to give a detailed account hereafter), these granules, during the formation of the globular cell within the body, which enclosed the materials from which the *Plæsonia* was ultimately developed, became congregated together at the posterior extremity of the *Oxytricha*, and remained there in a roundish mass, shut out from the cell, until the latter burst for the liberation of the *Plæsonia*, when, with the deciduous coverings, they passed into dissolution. Of the nature of their office I am ignorant, but they are sufficiently remarkable and constant to demand particular notice.

In the development of the sponge-cell, a similar set of large granules make their appearance at a very early period, and increase in number and size until they form as remarkable a feature as those above noticed. At this time they are about $\frac{1}{100}$ of an inch in diameter, of an elliptical shape, and of a light amber colour, by transmitted light; they are the colour-bearing granules or cells of *Spongilla*, and give the colour of chlorophyll to this organism when it becomes green.

Such granules would appear to be present in the earliest forms of *Ameba*; since they may be seen in mon- and diplo-ciliated monads, which, on losing these appendages, become polymorphic, and assume all the characters of *Ameba* in a young state. Here they not only resemble the granules of the sponge-cell, but at the same time appear to be of the same kind as those above described. Neither is it uncommon to see polymorphic cells, precisely like *Ameba*, bearing granules coloured like those of the sponge-cell; but the resemblance between the two organisms is so great, when the latter is free, that it is impossible to say which is which: however, they are greenish yellow, and elliptical, elongate in the foot of *Diffugia proteiformis* (Ehr.), which cannot be confounded with the cell of *Spongilla*. That these granules are not ovules in the sponge-cell, any more than in infusoria, their colour alone is sufficient to determine.

* Ann. des Soc. Nat., T. xix, p. 100, Zool.—1853.

Digestive Globules.—We shall use this term for spherical spaces of the sarcode, which are filled with water, and generally contain more or less food. They are formed in *Vorticella* and *Paramecium* in the following way, viz. as the particles of nutritive matter are drawn into the vortex of the buccal cavity, by the cilia which are disposed around its orifice for this purpose, they are forced down, with a certain amount of water, into the sarcode at the end of it, where they at first form a pouch-like dilatation, which sooner or later becomes constricted close to the buccal cavity, and, having been thus separated from it, passes off in spherical forms into the midst of the sarcode. The formation of one globule is soon followed by that of another; and so on successively the food, with a large quantity of water, is taken into the abdomen; sometimes the globule appears to contain nothing but water. When in the sarcode, it is continually undergoing circulation round the abdominal cavity, until the whole of its contents are digested, and resolved into a fluid, or until their nutrient parts are abstracted; the remainder then, still in a globular form, if there be sufficient water left to sustain this, is cast off through the anal orifice, as it arrives opposite this point during rotation. Frequently, however, nothing but the crude ingesta remain; for as soon as the globule begins to be circulated, the watery contents begin to be absorbed,—hence some particles of food are almost always present, without any globule round them; added to which, in many instances bodies pass directly into the sarcode without any globule at all. I cannot think, with most others, that there is any intestinal canal in the abdominal cavity, because the digestive globules and other particles of food are constantly undergoing circulation round the *whole* of its interior. In *Vorticella*, particles of food may occasionally be seen to circulate throughout, and accumulate, in every corner of its interior, particularly those which do not happen to be enclosed in globules. Moreover, the intimate resemblance which exists between the alimentary organs of higher infusoria, viz. *Nassula*, *Otostoma*, &c., and those of the binocular and so-called blind *Planariae*,—in the distance of the mouth from the anterior extremity, the presence of a buccal apparatus, and a simple sac-like stomach in the latter, lined with a layer of mucous substance (sarcode?), charged with the “spherical cells” about to be described, is so great, that with such a simple gastric organ in an animal so closely allied to these infusoria as *Planaria*, I do not see what reason we have, in descending the scale, to expect a more complicated digesting apparatus; but, on the contrary, one still more simple, in which there would be no stomach at all;—a condition which appears to me to be common to all the infusoria that have come under my notice.

In the *Amœba*, for want, apparently, of a channel of communication with the exterior, the introduction of food seems to take place directly through the diaphane ; and it is only now and then that the process by which the digestive globule is formed can be distinctly seen. Thus, on one occasion, where the particle about to be enclosed was a small *Amœba*, the latter, after struggling for some time, got under the former, when the large *Amœba* raised its diaphane in a dome-shaped cavity over the small one, and then, closing in below, after the manner of a sphincter, shut in the small *Amœba*, which, with a portion of water, immediately passed into the sarcode, under the form of a spherical digestive globule.* That the food is broken down by a digestive process in this way may be seen in the *Amœba*, where it frequently appears in all degrees of solution in the same individual ; viz. from an opaque, crude mass, to a blue or brownish fluid, according to the colour which the material may assume under its altered condition. In *Astasia* digestive globules also appear, but here the food is taken in through a distinct mouth, while in *Euglena*, the absence of such vesicles would appear to indicate that its support is derived in a different way.

Spherical Cells.—These cells, to which I have just alluded, abound in the sarcode of *Otostoma*,† and apparently in many of Ehrenberg's allotreta. In *Otostoma* they are of different sizes, because they are in all stages of development ; and, to keep up their numbers, without distending the animaleule, they must be continually undergoing rapid decay, as well as reproduction. The most remarkable feature in them is, that the largest, besides other granular bodies, contain several small cells, filled with a brownish yellow fluid, and these cells are also found free among the general group ; but what their ultimate destination is, as they do not appear to grow larger, or to become reproductive, I am ignorant. In the *Planariae* to which I have alluded, as well as in *Rotifera*, such cells nearly fill the stomach, and the large ones being more or less grouped together in the former, at the same time that they chiefly contain the yellow cells, gives the whole a sub-acinous or glandular appearance, very like the hepatic element surrounding the alimentary canal of some of the lower worms. It is also interesting to find here that each possesses a lash of cilia (about 50) projecting from one part of the cell, which, for some time after they are forced into the water through the anal orifice, or a rupture of the body, act by their whipping movements as imperfect locomotive organs, while, when these cells are fixed *in situ*, the same whipping movement must

* Ann. & Mag. Nat. Hist. vol. iv. p. 93.—1849.

† Idem, vol. xvii. pl. ix. fig. 6, b, b.

keep up a continued agitation of the gastric contents, which, if not conducted in a similar way in the infusoria, has its analogue there in the circulation of the digestive globules, and granular matters of the sarcodite. Although ovules may occasionally issue together with these cells from *Otostoma*, &c. as from the *Planariae*, yet the two can hardly be confounded; while in the *Planariae* the peculiar character of the ovule not only distinguishes it, but by careful manipulation the whole generative apparatus may be exposed outside the stomach.

That these cells in *Planaria* and *Otostoma* are homologous organs can hardly be doubted, both from their general characters and their correspondence in position; but what their office may be is at present unknown. Occurring, however, as they do, in the stomach of *Planaria* and *Rotifera*, where there is no other analogue of the so-called biliary follicles of the lower worms,* and being almost identical in *Otostoma* and *Planaria*, they not only ally these two organisms, but, at the same time, appear to be the homologue of the biliary follicles in each.

I have never seen any cells of this kind in *Ameba*, unless the "granules" already described be their analogues. It appears evident that these both in *Ameba* and the sponge-cell are the same, and that they are the seat of the green colour in the latter. Are the green granules of the sponge-cell analogous to the parts or cells respectively which hold the colouring matter or endochrome in the *Diatomeæ*, *Closterium*, *Spirogyra*, *Cladophora*, &c. and (through the latter), to the "green disks" or peripheral layer of chlorophyll-bearing cellules in the internode of *Nitella*, and those which, scattered irregularly through its moving protoplasm, are circulated round the cell of *Serpicula reticillata*? If so, the chlorophyll-bearing parts of the protoplasm in vegetables may be the analogue of the liver in animals. In some *Rotifera* the spherical cells appear to bear bile as green as grass or chlorophyll,† while in others it is

* By this I do not mean to class the Planarians with the worms. Mr. C. Girard, who has followed out the "Embryonic Development of *Planaria elliptica*," would ally them to the Gasteropoda. "Researches upon Neurterians and Planarians." 4to, Philadelphia, 1854.

† Since writing this, I have seen *Diglena catellina* (Ehr.) discharge the green matter from its alimentary canal, and retain nothing but the ordinarily coloured biliary cells; also *D. caudata* to have the whole of the soft tissues of its body coloured in this way, unless there be diverticulations of the stomach to this extent; so that I now begin to think this colour, which at first appeared persistent, to be adventitious, and gained from the *Euglena*, and, perhaps, chlorophyll-bearing protoplasm on which these species chiefly feed. Accidentally, perhaps, the bile may become green in any species of *Rotifera*, as in animals generally; and this appears to be the case with the endochrome of *Diatomeæ*.

yellow. The same diversity of colour occasionally manifests itself in the *Diatomeæ*; while in *Spirogyra* especially, the oil-globules and amylaceous deposits, which abound in abortive conjugation, are entirely confined to the green spiral-bands, thus corresponding, in one identically, and in the other transitionally, with the fat and sugar which are found in the liver of man; the colouring matter in all of course being, when present, a mere indication *cæt. par.* of the nature of the organ. How the colour-bearing cellulæ of the spherical cells are produced in *Otosoma* and *Planaria* I am ignorant; but in some Rotifera (*ex. gr. Brachionus Pala*, Ehr.) they present themselves at an early period in a circular or discoid group, attached to the cell-wall, and thus, with the absence of the nucleus, closely resemble a granulated state of that organ.

Vesicula.—I would propose this name for the “Contracting Vesicle,” on account of the latter being a loose and inconvenient term in description. It is certainly the most striking organ of the infusoria, from its defined circular outline when distended, its hyaline aspect, and above all its sudden disappearance and gradual return at intervals, which gives it a pulsatory character, so like that of a heart, that at first we are inclined to conclude that it must be the representative of this organ in the infusoria. Spallanzani considered it a respiratory organ;* Ehrenberg the male organ of generation;† and Siebold a circulatory organ.‡ The following facts, however, would seem to show that it is neither of these, but an excretory organ, viz. :—

1st.—It is always seen either close to the pellicula, or close to the buccal cavity, and always stationary. Thus, in *Paramecium aurelia*, it is close to the surface, and although it of course passes out of view as the animalcule turns on its long axis, yet it always reappears, after contraction, in the same place; while in *Forficella* it is attached to the buccal cavity, and, being centrically situated, seldom passes out of view, except when it disappears under contraction, after which it also reappears in the same place.

2nd.—In *Actinophrys Nol.*|| and other *Amœbæ*, during the act of dilatation, the vesicula projects far above the level of the pellicula, even so much so as occasionally to form an elongated, transparent, mammilliform eminence, which, at the moment of contraction, subsides precisely like a blister of some soft tenaceous substance, that has just been pricked with a pin.

3rd.—Lastly, when we watch the contracting of the vesicula in a

* *Ap. Dujardin, op. cit.* pp. 103, 104. † *Idem, pp. 105—108.*

† *Ap. Claparède, Ann. & Mag. Nat. Hist. vol. xv. p. 212.—1855.*

|| *Idem, loc. cit. pl. viii. fig. 1.*

recently encysted *Vorticella*, we observe that at the same moment that it contracts the buccal cavity becomes filled with fluid; and further, that this fluid disappears from the buccal cavity, and all trace of the latter with it, long before the vesicula reappears—thus proving at once, that the fluid comes from the vesicula and does not return to it, whatever may become of it afterwards.

The position of this organ, then, its manner of contracting, and the buccal cavity of encysted *Vorticella* becoming filled with fluid the moment it disappears (where we know it to be attached to the buccal cavity, and not to the pellicula), are almost conclusive of its excretory office. We have now to find out how this fluid is brought to the vesicula.

It will be remembered that there is a series of fusiform sinuses which surround each of the vesiculae in *Paramecium aurelia*, and some other animalcule of this class, on which Spallanzani made the important observation, that as they become empty the vesicula becomes filled.* This may be easily seen, as well as that they do not re-appear until some time after the vesicula has contracted. Thus we infer, that the fluid with which the vesicula is distended comes through the sinuses, but is not returned by them to the body of the *Paramecium*.

Now in some cases, faint hyaline or transparent lines may be seen to extend outwards† from each of these sinuses, and which lines, Eckhard has stated, "traverse the body in a stellate manner." Hence, when we add Eckhard's evidence (which I have been able to confirm in a way that will be presently described) to the observation of Spallanzani, and connect this with the facts already adduced in favour of the excretory office of the vesicula, it does not seem unreasonable to conclude that the whole together forms an excretory vascular system, in which the vesicula is the chief receptacle and organ of expulsion.

While watching *Paramecium aurelia*, I on several occasions not only observed that the vesiculae were respectively surrounded by from seven to twelve pyriform sinuses of different sizes, and that lines extended outwards from them in the manner described by Eckhard; but I further observed that these lines were composed of a series of pyriform or fusiform sinuses, which diminished in size outwards, and frequently I could trace as many as three in succession, including the one next the vesicula. Hence, I am inclined to infer that this vascular system throughout is more or less composed of chains of such sinuses, and that all have more or less contractile power like that of the vesicula. Just

* Spall. ap. Dujard. op. cit. p. 103; Spall. Opus. phys. trad. franc. t. i. p. 248.

† Ann. & Mag. Nat. Hist. vol. xviii. p. 448.—1846.

preceding death, when *Paramecium aurelia* is compressed, and under other favourable circumstances, these sinuses run into continuous hyaline lines, and may not only be seen extending in a radiated, vascular form across the animalcule, but even branching out round the position of the vesicula, which, having now become permanently contracted, has thus caused them to become visible. They enter the lower or inner part of the organ, and at this point, therefore, are pushed inward as the vesicula becomes distended. Under the same circumstances, also, when the vesicula is slowly dilating and contracting, it may be seen to be attached to a small papilla on the surface, about twice the diameter of those which surmount the trichocysts,* and through which it probably empties itself. In *Otostoma* there appears to be a similar arrangement of vessels round each vesicula, and here also they seemed to me to be branched,—at least such was my impression after having watched this animalcule for a long time, in order to determine the point.

In *Ameba* and *Actinophrys* the vesicula is generally single, sometimes dual, and not unfrequently in larger *Ameba* in greater plurality. In *Euglypha* I have not been able to recognise it, but in *Arcella vulgaris* and *Diffugia proteiformis* it may be seen in great plurality, situated round the margin of that part of the animalcule which is within the test; and from their always reappearing, after contraction, in the same places respectively, we may infer that the situation of the vesicula in *Ameba* and *Actinophrys* also is fixed, though from their incessant polymorphism it appears to be continually varying in position. In *Paramecium*, and Ehrenberg's enterodela generally, the vesicula is either single or dual. When it exists in great plurality in any of these (ex. gr. *Chilodon cucullatus*, Ehr.), this appears to depend on accidental dilatations of the sinuses in connection with it. Thus, in the animalcule just mentioned, where the vesicula is single, and seems to be sub-terminal and lateral in its normal position, it is not uncommon to meet with a group in which every member presents a variable number of contracting vesicles, variably also and irregularly dispersed throughout

* These are narrow, fusiform cells, arranged perpendicularly, and at some little distance from each other, under the pellicula, where they thus form a layer all over the body, and each, according to Dr. Allman, contains a delicate, resilient thread, coiled up in its interior, which, just after the cells have been forcibly pressed out into the water, by crushing the animalcule, causes them to assume, for a second, a circular form, and then burst, through which the thread is set free, and, lying rigid on the glass, presents the form of an acicular crystal, terminated at each end by a pointed extremity, one of which, being more attenuated than the other, appears like an appendage. To these cells Dr. A. has given the name of "trichocysts." (Qu. Jl. Microscop. Sc. vol. iii. p. 177.—1855.)

the body, without one being in the true position of the vesicula. That the vesicula does make its appearance now and then may be inferred, as it perhaps may also be inferred that from over-irritability, or some such cause, it does not remain under dilatation long enough to receive the contents of the sinuses; and hence their accidental dilatation, and the appearance of a plurality of vesiculae. That, also, the sinuses which are in the immediate vicinity of the vesicula do empty themselves into it may be easily seen, when both are present; and what takes place near it seems not unreasonable to infer may, through a concatenation of communication, take place from a distance. At the same time, the sinuses of this system in the sarcode of *Amœba* not only seem to burst into each other, and into the vesicula, but when the latter has contracted, another sinus, partially dilated, and situated near the border, may be seen to swell out and contract after the same fashion, before the reappearance of the vesicula. Then there is no knowing how many vesiculae there may be in *Amœba*; while *Actinophrys Sol* (Ehr.) is surrounded by a peripheral layer of vesicles, which, when fully dilated, appear to be all of the same size, to have the power of communicating with each other, and each individually, to contract and discharge its contents externally as occasion may require; though, generally, one only appears and disappears in the same place. In *Oxytricha* the vesicula is single or dual; but in *Plæsconia*, as far as my observation extends, always single. The vesicula is always single in *Vorticella*, where it is attached to the buccal cavity close to the anal orifice, as in *Rotifera* and *Cotacium vesiculosum* (Ehr.). In one species of *Vorticella* there is a distinct pouch for these excretory orifices, about half-way up the buccal cavity. In *Colepina* the vesicula occupies the posterior extremity.

Its existence in *Astasia*, *Ayisonema*, and *Euglena* can only be determined from inference. They all have a transparent vesicle situated close to the anterior extremity; and in *Astasia* we know that it is thus situated close to an external orifice, and the buccal cavity. In *Ayisonema* it seems to alter in size and shape, as it does in some *Ayete*, without completely contracting; and also in *Astasia* it is at one time more defined and apparent than at another; but this may be owing to change of position in the entire animalcule. In *Polytoma Uvella* it is similarly situated, but double, and has been seen to contract by Schneider;* and in a small colourless animalcule, very much like a young *Astasia*, as well as in a minute species of *Chlamidomonas* (Ehr.), I have frequently seen this vesicle contract and dilate in the manner of the vesicula; so that

* Ann. & Mag. Nat. Hist. vol. xiv. p. 322.—1854.

there can be little doubt about the vesicle in the anterior extremity of *Astasia*, *Anisonema*, and *Euglena*, being the homologue of the vesicula, though in the latter the red body be appended to it; which, however, is not the case in the *Chlamidomonas* mentioned, where it is nearly in the middle of the body, and peripheral, while the vesicula is in the anterior extremity.

The quiescent state of the vesicula in *Astasia*, *Euglena*, &c. may be an approach to its disappearance altogether as a distinct organ, and therefore a step nearer to the vegetable kingdom. But Schneider, in allusion to this, quotes a passage from Cohn, in which the latter observes, that "internal pulsating spaces" have been discovered in "certain genera of Algae"; on which Schneider justly remarks, that if they "occur in the swarm-cells of *Confervae*, they certainly cease to be a characteristic of animal nature" * ;—thus rendering useless another distinguishing point between animals and plants at this part of the organic kingdom, which after all, perhaps, may be found to have its homologu in the vacuoles of the vegetable protoplasm.

That the vesicula is a distinct organ, and not merely a space like the digestive globule, might be inferred from its always occurring in the same place in the same species; but in addition to this, the fact was on one occasion most satisfactorily demonstrated to me by its remaining pendent in a globular form to the buccal cavity of a *Vorticella*, when, by the decomposition of the sarcode, and evolution of a swarm of rapidly moving monadic particles, these two organs, with the cylindrical nucleus or gland, though still slightly adhering to each other, were so dissected out as to be nearly separate; and thus yielding in position from time to time, as they were struck by the little particles, their forms and relative positions respectively became particularly evident.

Although globular in shape, yet, as before stated, it is accompanied in *Paramecium aurelia* by a variable number of pyriform sinuses, which are arranged round it in a stellate form. In most of the other animalcules these are globular, and, under exhaustion of the animalcule from various causes, are frequently so distended, and thus so approximated, as to assume the appearance of an areolar structure, immediately in contact with the vesicula. Each globular sinus, however, would appear to be the proximal or largest of a concatenation of smaller ones, which diminish in size with their distance from the vesicula. The vesicula becomes doubled preparatory to fissiparation, and therefore appears

* *Loc. cit.* p. 330.

dual in *Vorticella*, and quadruple in *Paramecium*; and it is interesting to find that in the metamorphosis of the former into *Acineta* it frequently acquires a plurality similar to that which obtains in the Rhizopoda generally.*

Of the use of the vesicula, and its vascular system, we are at present ignorant, further than that its functions are excretory; and when we observe the quantity of water that is taken into the sarcode with the food, and try to account for its disappearance, it does not seem improbable that the vesicula and its vessels should be chiefly concerned in this office. Another service, however, which it performs, is to burst the spherical membranes of *Vorticella* and *Plesconie* when they want to return to active life after having become encysted: this it effects by repeated distension, until the lacerated cyst gives way sufficiently for the animalcule to slip out. At these times, also, the animalcule is rendered so spherical by this distension that it is also evidently one way by which the infusoria might assume this form. Hence, in describing the sarcodes, I have expressed a doubt whether the water in an *Amœba*, when distended in this manner, be in its centre or in the cavity of the vesicula. Certainly, when *Amœba* is in the form of a sphere, I never have been able to see the vesicula, while all the other elements of the cell have been perfectly plain; added to which, under these circumstances, a part of the cell wall is generally transparent, from the absence of the sarcodes and its granules, which would be the case if the vesicula were the cause of the distension, since in *Amœba* it is attached to the pellicula, and therefore no sarcodes exists immediately opposite this point.

Should it have any other uses, they are probably similar to those of the "Water Vascular System" of Rotifera, which in *Brachionus Pala*, one of the largest species of this class, consists of a corrugated sac when empty (like the bladder of mammalia), opening by a constricted neck into a heart-shaped cloaca close to the termination of the alimentary canal; and, when distended, presenting (*uihi*) a single vessel opening into its fundus, and then passing down through its side towards the neck, where it divides into two, which respectively run up laterally to the anterior extremity of the body, bearing in their course four monociliated (Huxley)† pyriform diverticula, and probably terminating, as in *Lacinularia*, partly in junction and partly in blind tubes. The vacuolar structure attached to these vessels may be analogous to the vacuolar structure connected with the vesicula in the infusoria, and it would be

* See particularly Stein's work on the Development of Infusoria.

† Qy. Jl. Microscop. Sc. vol. i. p. 7.

interesting to determine if the vacuoles in it occasionally diminish in size or disappear, or become dilated when from disease or approaching death the vesicula itself is unnaturally and permanently distended. Should the lateral vessels not terminate in *Brachionus Pala*, as above mentioned, then they must, as it appears in the other Rotifera, open into the vesicula close to its communication with the cloaca.

It might here be asked if all vacuolar dilatations of the sarcode belong to this excretory system of sinuses, that is excepting those made by the buccal cavity in the manner mentioned? Certainly, where there is a plurality of actively contracting vesicles, without the appearance of the vesicula, as in *Chilodon cucullulus*, we may, as before stated, attribute this to a kind of over-irritability or constrictive spasm of the vesicula, and, therefore, that these vesicles are accidental dilatations of the sinuses in connection with it; as we may set down the dropsical state of *Himantophorus Charon* (Ehr.), and other animalcules of the kind, to an opposite condition of this organ, viz. that in which it is unable to relieve itself of its contents: this I have often seen occur under my own eyes. But there is an intense vacuolar state of the sarcode which occasionally presents itself in *Amœba*, that makes it look like an areolar tissue composed of vesicles diminishing to a smallness that cannot be determined by the microscope,—such as is seen in the protoplasm of the vegetable cell: whether this still be a part of the vesicular system or not I am unable to decide.

Lastly, from the presence of the vesicula in *Spongilla*, and its being so constant in the Rhizopoda generally, and so numerous in *Arcella vulgaris*, it does not seem altogether unreasonable to infer that the streams of water which issue from the great canals of *Spongilla* are produced by the continued pouring into them, from the vesiculae of the different sponge-cells, the superfluous water which they imbibe by endosmosis, apparently, during nutrition; for the type of *Spongilla* is to be surrounded with a general pellicula, in which there is only one excretory opening, and through which pellicula the ends alone of the spicula in bundles project; nor does it seem altogether far-fetched to conceive that the offices of glandular organs in higher developments may be performed, in some instances, after this fashion.

Nucleus.—By this term we shall understand, for the most part, an organ situated in the outer portion of the sarcode, which, when well marked, presents under the microscope the appearance of a full-moon (to use a familiar simile), with similar slight cloudinesses. It is discoid in shape, of a faint yellow colour, and fixed to one side of a transparent capsule, which, being generally more or less large than the nucleus

itself, causes the latter to appear as if surrounded by a narrow pellucid ring. In this state it is invariably present in *Anæba*, *Actinophrys*, *Spongilla*, *Astasia*, and *Euglena*, though difficult at first to recognise; particularly in the two latter families, where the pellucid space or capsule, at the bottom of which it is situated, is often the only visible sign of its presence. In *Diffugia proteiformis* it of course cannot be seen, from the thickly encrusted state of the test; but in a smaller and less encrusted species, which might be called *D. tricuspis* (from the trefoil form of the opening of the test), as well as in *Euglypha*, its position is posterior, and evident, from the largeness of the capsule, though the nucleus itself is so faint that even in *Euglypha* it can only occasionally be distinguished; while in *Arcella vulgaris* (Ehr.) it is constantly double and opposite.—In *Anæba diffluens* the nucleus itself occasionally presents a pellucid spot or punctum in its centre.

In *Vorticella* there is a long cylindrical organ, which appears analogous to, if not homologous with, the nucleus, and this, in a large *Epistylis* common here, and some other species of *Vorticella*, is wrapt once round the upper part of the buccal cavity, in the same manner as the ovary is wrapt round the visceral organs of *Salpa* among the Tunicata. Stein states that after *Vorticella miscrostoma* has become encysted, this organ divides up into embryos, which, when the parent integument bursts, come forth like "*Monas kolpoda* or *Monas scintillans*"; and he "assumes" that these monads, after having become fixed and stalked, pass into young *Vorticella*,* an assumption which can hardly be doubted, though it may be some time before chance favours its demonstration.

In *Otosoma*, and many forms of Ehrenberg's enterodelous class of animalcules, there is a similar organ, either of a circular, cylindrical, or fusiform, elongated shape. Also in *Oxytricha* there is something of the kind, and in *Himantophorus* (*Charon*, Ehr. *mihi*) it extends nearly all round the body, commencing from the posterior extremity, and terminating on the right side close to the vesicula.

The cylindrical organ in *Vorticella* not unfrequently presents a granular appearance, and the granules, which are minute, but uniform in size, appear to occupy the periphery; but whether they are inside or outside the wall of the cylinder, or in the substance of the wall itself, I have not been able to determine. Stein places them inside, in the form of a granular cylinder, and within this "nucleoli," †—nucleated, discoid bodies, into which the nucleus becomes divided.

* Ann. & Mag. Nat. Hist. vol. ix. p. 474 et 447.

† Die Infusionsthiere, &c. 4to, Leipzig, 1854. Taf. iv. fig. 24.

In the rhizopodous cell which inhabits the protoplasm of the *Characeæ*,* it is at first uniformly clear and transparent, then semi-opaque, and sub-granular; afterwards two or more distinct granules make their appearance; and finally, it becomes wholly granular, and much enlarged, or undergoes fissiparation; and thus gives origin to more cells, like the cytoplasm of the vegetable kingdom.

Use.—It is impossible, in the present state of our knowledge, to specify the uses of the nucleus. One point, however, is evident, that it appears very early in the development of the freshwater Rhizopoda sponge-cell, &c.; and another, that it bears a close analogy to a similar organ in the vegetable cell, viz. the cytoplasm, which also is the primary organ of this cell; and therefore, perhaps, we might term it the presiding organ, or consider that such are its primary offices over the development and life of these cells respectively. If we trace it from the Rhizopoda into the vegetable kingdom, we shall find it occupying the very same position relatively in *Amœba* that it does in the cell of *Serpicula verticillata*. † Thus, in some amœbous cells which settled down from their spherical into the plane reptant forms, the following sequence from without inwards was distinctly seen, viz. 1st, the pellicula and diaphane; 2nd, the molecular sarcode bearing the nucleus, and a layer of greenish granules externally; 3rd, the aqueous fluid of the centre;—and in the spine-cell of the leaf of *Serpicula*—1st, the cellulose cell-wall; 2nd, the molecular protoplasm, in which are embedded the green granules (viz. cells or organisms in which part of the protoplasm bears chlorophyll) and the cytoplasm; 3rd, the aqueous fluid of the centre. The difference between cellulose and pellicula, and the absence of the vesicula, &c. are points which have so little to do with the analogy in question when the latter is followed up through *Astasia*, *Euglena*, *Navicula*, *Closterium*, &c. into *Oedogonium*, *Nitella*, and lastly *Serpicula*, that very little doubt will, I think then remain, of the offices of the nucleus in *Amœba* being similar to those of the nucleus of the plant-cell, whatever these may hereafter prove to be.—Here, again, I would return for a moment to the cause of sphericity in *Amœba*, and submit whether the cavity containing the distending fluid is that of the vesicula or the centre of the sarcode; since the aqueous cavity of the vegetable cell may then be analogous to the vesicula; for, as before stated, I have never been able to succeed in detecting the vesicula in *Amœba*.

* Ann. & Mag. Nat. Hist. vol. xvii. p. 101.—1856.

† This aquatic plant is selected for comparison because the circulatory movement is well marked in the cells which occupy the body of the leaf, and the cytoplasm and protoplasm in the spine-cells of the margin.

when under a spherical form ; although, the moment it becomes plane and polymorphic, this organ reappears, of its usual size, and endowed with its usual activity.

Much, however, as the nucleus may at first appear to be a presiding organ, there can be no doubt, from what will presently be stated, that its ultimate destination, in some organisms at least, is to pass into granules which become new beings.

Ovules.—This term will be applied to a number of discoid, or globular, nucleated cells, which appear together in the sarcode of some of the infusoria. At an early stage in *Spongilla*, *Anæba*, *Euglypha*, *Astasia*, and *Euglena*, these bodies consist of a transparent capsule, lined with a faint yellow film of semi-transparent matter, which, subsequently becoming more opaque and yellowish, also becomes more marginated or distinct, and assumes a nucleolar form. In *Spongilla* there is also a delicate, pellicular layer, which is endowed with a low power of movement.

I first noticed these ovules in the seed-like bodies of *Spongilla*, where they are enclosed in transparent globular sacs,* each sac holding more or less ovules, which are discoid in form, of different sizes, and accompanied by a great number of active molecular granules ; and during the past year I have frequently seen such in *Anæba (diffusa mihi)*†, where they have been equally numerous, have borne the same characters, and have been accompanied by a number of active molecular granules, as in the transparent globular cells of the capsules of *Spongilla*. They occur also in *Euglypha alveolata*,‡ congregated round the hyaline capsule of the nucleus, from four to fifty, and mostly of the same size, but always globular, and accompanied also, as in *Spongilla*, by molecular granules. Such ovules may also be seen similarly situated in *Diffugia tricuspis* (H. J. C.), and in *Arcellina dentata* (Ehr.) ; enclosed in the latter in an ovoid capsule, which nearly fills the test. In *Actinophrys*, also, they appear to have been seen by M. Nicolet, as will be mentioned hereafter.

Astasia and *Euglena* constantly become filled with discoid cells of a similar kind, but in those of the former I have not been able to distinguish the capsule from the internal contents, on account of their smallness, and the incessant motion of the animalcule. In *Euglena*, however, they are very evident, and it is worthy of remark that each partakes of the

* Ann. et Mag. Nat. Hist. vol. iv. p. 87.—1840. Of the formation of the seed-like body, I need not say more here, than that it consists of a capsuled aggregation of ovule-bearing sponge-cells ; while *Anæba* presents the same appearance, when pregnant with ovules, as one of these cells, and becomes capsuled singly.

† Dujardin, Hist. Nat. des Zoophytes Atlas, T. 3, fig. 1.

‡ Dujardin, tab 2, fig. 9.

form of the *Euglena* to which it belongs. Thus in *E. acus* it is long and cylindrical; in *E. deses* oblong, compressed; in *Crumenula texta* ovoid, compressed; in *Phacus*, circular, compressed, &c.

In *Spongilla* and *Amœba* these ovules follow the motions of the sarcodæ, in which they appear to be loosely imbedded; they also undergo partial transposition in *Astasia* and *Euglena*; but in *Euglypha* and *Difflugia* are located round the globular hyaline capsule of the nucleus, at the posterior part of the body,—a position which it is well to remember, for although apparently unconnected in all, with the nucleus and its capsule, and diffused generally throughout the sarcodæ in *Spongilla*, *Amœba*, *Astasia*, and *Euglena*, yet in *Euglypha* and *Difflugia*, which we shall hereafter find the best for typical reference, they are undoubtedly developed in the neighbourhood of the nucleus, and therefore confined at first to a particular part of the body.

In many of Ehrenberg's entroctodelous infusoria it is not uncommon to see a number of defined globular bodies, of nearly equal size, and of a faint, opaque, yellow colour, which closely resemble ovules,—*ex. gr. Amphileptus fasciola* (Ehr.), *Himantophorus Charon* (Ehr.), &c.; nor is it improbable that many of his Trachelina, which come near *Planaria*, possess ovules similar to those which are found in the latter; but, from being so much mixed up with the spherical cells, pass equally unnoticed while in, as well as when out of the body, under such circumstances. M. J. Haime, however, has distinctly seen instances in which these bodies have been ejected from infusoria, and have passed into locomotive animalcules under his eye. Thus he states in *Plæsconia* they form a group of forty to fifty in the middle of the body, are round, issue one by one, remain tranquil some time, then develope two filaments, one in front the other behind, and move about rapidly. In an "undescribed" species of *Dileptus* they are whitish, and form a wreath, extending almost throughout the whole length of the body, become yellow towards the anal extremity, where they pass out with the remains of the food, soon develope two filaments, opposite, and move about rapidly. In *Paramecium aurelia*, M. Haime states that an ovary appears some hours before death, about the middle of the body, which becomes filled with about sixty little nuclei; these increase in size, burst the ovi-sac, and thus pass into the body of the parent, from which they finally escape by an opening in the tegumentary covering, formed by the diffluence of the latter, and the ovi-sac follows them.*

Spermatozoids.—This term is provisionally applied to granules

* Ann. des Sc. Nat. Zool. T. xix. p. 131, foot-note.—1853.

which are originally developed from the nucleus in *Amœba*, *Euglypha*, and *Spongilla* (?). In *Amœba* the process appears to commence by an increase of size in the capsule of the nucleus, which becomes more or less globular; at the same time the nucleus itself becomes uniformly granular; the latter then increases in size, so as to occupy a third of the interior of the animalcule, and then undergoes, apparently, duplicative sub-division, for the mass is sometimes seen to present a single groove, which passes through the centre, and ultimately becomes divided up into several segments. These segments assume a circular compressed, or globular form, and continue entire until the granules or spermatozoids of which they are composed become fully developed, when the latter acquire the power of locomotion, and thus separate from each other; meanwhile the original capsule of the nucleus for the most part disappears. In this way some individuals out of a group of *Amœba diffusa*, bearing such granules, were seen moving about, even when so reduced that hardly anything but their cell-wall, and the one or two spherical segments of the granulated nucleus that remained in its interior, were left; upon being delivered of which it may be presumed that they became effete or died. Sometimes these segments are evidently held together by a soft mucous cell, which, being polymorphic, assumes the form of *Actinophrys*, and thus exhibits a locomotive power; while at others the cell becomes firm, transparent, and spherical, and the granules do not leave it until they become endowed with locomotion. When the latter is the case, the spermatozoids may be seen, if fully developed, to be bounding about their respective capsules, while the capsules themselves are still rolled on in the sarcode of the *Amœba* under progression. At other times the whole mass of spermatozoids, all separated, and having left their capsules, may be seen to fill the body of the *Amœba*, while she is still under active polymorphism and locomotion. Lastly, the parent sometimes dies in this state, and then the mass of spermatozoids may be seen to undergo gradual disintegration, as the granules, by twos and threes, or more, disentangle themselves from the sarcode, and bound off into their new element. These granules or spermatozoids in *Euglypha* average from 17000 to 18000 of an inch in diameter; about four of them would make the diameter of the largest ovules, which are, again, about the width of human blood-globules.

In *Euglypha alveolata* a similar development takes place round the anterior part of the capsule of the nucleus; but from the concealed position of the latter, I have not been able to see it distinctly originate in the nucleus, as in *Amœba*. The segments here have always been

compressed, probably from the soft polymorphic state of the mucous cell which encloses them admitting of their assuming a plane or reptant actinophorous form ; and in this way they are carried out of the *Euglypha*, which, like *Amœba*, perishing on their development, and passing into decomposition, thus allows them to quit the parent cavity ; at other times they separate close to the hyaline capsule of the nucleus, and finally swarm about in the test, generally. Although this development, as well as that of the ovules, takes place more profusely in different than in the same individual, yet it is by no means uncommon to see, in a group of ovule-bearing *Euglypha alveolata*, individuals with both developments in them at once ; and with no gradation in the size of the ovules to indicate that they originated in the granules, or *vice versa*,—the two developments thus appearing distinct ; and this seems to be confirmed by what takes place in a larger variety (?) of this species of *Euglypha*, where there is a test something like that of the parent developed in the interior, and within this a spherical capsule, provided with a straight tube, which extends to the pointed end of the test in which it is immediately enclosed. At this time the animal has entirely disappeared, and the contents of the spherical capsule, having undergone segmentation, assume the form of circular masses of granules, like those developed from the nucleus in *E. alveolata* ; after which the granules separate, and pass out of the straight tube, which is slightly patent at its free extremity. Other tests of the same variety may be seen more or less filled with ovules, as before described.

Lastly, in *Spongilla*, there are always many cells to be found in that part of the mass where the seed-like bodies are being developed, partly filled with similar granules, loose or in a circumscribed group ; but I have not yet been able to determine whether this development is nucleolar, or ovarian at an early stage. It is certainly most like the granular development of the nucleus in *Euglypha* and *Amœba*.

In *Astasia*, irregular globular botryoidal masses, dividing up into spherical cells, colourless and translucent, or of a faint, opaque, yellow tint, present themselves so frequently (and generally inversely developed with the ovules, as in the Rhizopoda), that I cannot help thinking that they are developments from the nucleus ; but from not having seen them present that granular aspect which characterises this development in the Rhizopoda, I have not been able to determine satisfactorily whether they are parts of the latter, or that kind of division of the green sarcodite into green spherical cells which appears to be one mode of propagation in *Euglena*.

In *Euglena*, also, I have described a development of the nucleus, partly

under the idea that it might be a parasitic rhizopodous development; but now it appears to me to be a simple enlargement, granulation, and segmental development of this body into polymorphic, reptant, mucous cells, filled with spermatozoid granules, as in the Rhizopoda.*

Finally, from what organs, in the freshwater Rhizopoda, *Astasia*, and *Euglena*, are the ovules and the spermatozoid granules developed?

Of the origin of the latter from the nucleus there appears to me to be no doubt; for independently of the changes taking place in it which have been mentioned, I have never been able to see the nucleus and its capsule in its original form when the spermatozoid mass has been present, though I have occasionally, in *Amœba*, and almost always in *Euglypha*, seen the empty globular capsule in connection with the latter. In *Amœba*, before the spheroidal divisions of the nucleus have separated from each other, they frequently appear in the form of a botryoidal mass, projecting from one part of the capsule.

But, as regards the ovules, although they are unquestionably developed too, around the globular capsule of the nucleus in *Euglypha*, yet the fact of their being developed throughout the greater part of the sarcode which lines the cell of *Euglena*, and the same in *Astasia*, which is closely allied to *Amœba*, while in the latter they appear also to be developed from the sarcode generally, seems to indicate that they are developments of some part or parts of the sarcode—perhaps some of the molecule. That the two developments, viz. that of the ovules and spermatozoid granules, present themselves together in *Euglypha*, has already been stated, and the facts of the ovules in *Euglena* first becoming developed outside the capsule of the nucleus, and the granular development of this body following it, shows that the ovules are not developed from the nucleus. The capsule, therefore, in *Euglypha*, under these circumstances, as well as when there are ovules alone present, is often seen minus the nucleus; and the same in *Amœba diffusa*, where it may be observed rolling about with the ovules when the latter have, for the most part, reached their largest size. In these instances, too, the granules of the nucleus, if the latter has undergone this transformation, may be dispersed among the general mass, as the nucleus on such occasions has, if not absent, appeared faintly marked, probably from having become effete or atrophied,—the ovules and spermatozooids appearing to be inversely developed.

Nicollet has stated that in *Actinophrys* the generative organs consist of a central spherical membrane, enclosing little globules, which are the

* Ann. & Mag. Nat. Hist. vol. xvii. p. 115.—1856.

rudiments of "eggs," surrounded by a "gelatinous granular layer," the granules of which appear to be the reproductive organs.* But this simple statement, though bearing the semblance of fact, is too meagre, without illustrations, to be of any use. If his "spherical membrane" be the same as our capsule of the nucleus, after the latter has become globular, then certainly the ovules are not contained in it in *Euglypha*. Stein also figures the nucleus of his *Actinophrys oculata* in accordance with Nicolet's observations, viz. with a granulated nucleus, fixed in a spherical capsule, surrounded by a zone of granular plasma (?).† This, as will be seen hereafter, is very like the state of the nucleus in the rhizopodous cell of the protoplasm of the Characeæ, when the former is undergoing reproduction.

With reference to the organs of generation in the other infusoria, I can state no more than that while there is a fusiform nucleus in *Otostoma*, I also constantly saw a bunch of string-like filaments floating about its interior, which appeared to be attached near the buccal cavity; and although I could make out nothing more, I could at the same time only liken these to the generative apparatus in the *Planaria* mentioned, which floats round the buccal cavity and upper part of the membranous stomach in a similar manner.

Impregnation.—In the *Amœba* and in *Actinophrys* a union of two individuals is not uncommon, and many have noticed this in the latter. It has occurred to me, also, to see it in a species of *Amœba*, which, from its circular form, and the prolongations only taking place from one point of the circumference, appeared thus to present an anterior extremity, by which extremities several pairs of the group were united; and on one occasion two separated under my eye, when an attenuated prolongation of one seemed to be drawn out through a thick prolonged portion of the other. More convincingly and frequently, however, this union was observed in a group of *Euglypha*, where the anterior extremity of the body is distinct. Here the protruded parts, after having been united for some time, began to separate by constriction at the point of contact, which, soon diminishing to a mere mucous thread, became smaller and smaller, and more elongated, as the two individuals, retreating from each other, withdrew themselves into the bottom of their test respectively, from which they appear on such occasions never again to emerge. Lastly, in a group of *Euglena deses*, several couple appeared united by the tails, not only to one another, but fixed to the watch-glass at this point, where they continued until

* Compt. Rend. vol. xvi. p. 115.—1848.

† Op. cit. tab. v. figs. 25—28.

each sunk down, close to the other or separate, into capsuled forms filled with ovules,—a state which appeared so much the more to be the result of impregnation, from the number of couples thus united presenting every stage of ovigerous development in their interior, from mere molecular sarcodes to repletion with full formed ovules. It is not an uncommon thing to see, among a group of *Euglena*, individuals chasing each other, becoming united head to head, head and tail, or tail to tail, and then separating with difficulty by a whirling motion, as if the bond of union were a mucous thread, which could be only twisted off in this manner. Two *Euglena* may also sometimes be seen united by the intertwisting of their filaments only, just like the congress of two snails.

All these unions appear very much like so many acts of conjugation; but when we find *Euglypha* as well as *Arcella* united, not only in pairs, but triply and quadruply, in this way, and the same with *Euglena viridis*, the connection of these phenomena with reproduction, as Claparède has stated,* becomes "exceedingly doubtful"; particularly as we have seen the spermatozoid granules developed from the nucleus and among the ovules; and this granular spermatozoid development, if it be one, does not take place until after conjugation. At the same time, in one group of *Euglypha*, nothing but spermatozooids were developed, while in another hardly anything but ovules appeared; and it was only here and there that both were found together; again, in the larger variety of *Euglypha*, the granules were developed in a distinct apparatus, and the ovules in the same manner as in *E. alveolata*, viz. in the posterior part of the body, outside the capsule of the nucleus.

Lastly, we come to the question whether or not these granules are spermatozooids? That the ovules in *Spongilla* pass into polymorphic cells I proved by experiment some years since; † and lately, I have repeated similar experiments, with the same results. Moreover, I have seen the ovule of *Euglypha* in every stage, from its first appearance in the test to the time when it has acquired the power of putting forth rhizopodial prolongations, after which the tests of very small *Euglypha* presented themselves in the same basin, which did not appear before the parents had died off, and left their ovules to shift for themselves. Hence this is one mode of propagation among the Rhizopoda, whatever the granules which we have provisionally called spermatozooids may be. Then, also, it has often occurred to me to see circular groups of spermatozooids undergoing disintegration or dehiscence in the test of

* Ann. & Mag. Nat. Hist. vol. xv. p. 286.—1855.

† Idem, loc. cit.

Euglypha, while ovules were present, and granules like the former swarming round the latter at the same time; as well as granules of the same kind in *Amœba diffusa*, where the ovules have been far advanced in development. Also in *Spongilla* similar granules abound in the transparent globular sacs of the capsule which contain the ovules; and when the latter are set free by forcibly bursting the former, these little granules crowd round the large ovules so markedly that I made this observation several years since,* when I little thought that there was any reason for thinking them organs of impregnation. Lately, however, I have observed, that full half the larger ovules of the seed-like body, under this condition, have one of these granules in different degrees of connection with them, from simple approximation to almost undistinguishable incorporation; also that when the internal contents granulate on the third or fourth day after they have been set free, the prominence caused by the appended granule does not disappear until the whole ovule has passed into a polymorphic cell; that is, that after this no capsule or anything else remains behind, to indicate that the granule and its capsule, with this prominence, have not wholly become transformed into the new sponge-cell. This granule, however, is not entirely confined to the larger ovules, where it is for the most part affixed to the margin, but is also presented here and there by many of the small ones. In the larger ovules it bears, in size, the proportion of about one to eight, and the largest ovules average about $\frac{1}{800}$ of an inch in diameter. About twelve hours after the ovules and granules have been set free in the manner mentioned, into distilled water, in a watch-glass, they, as well as the granules, exhibit a great deal of motion, which lasts up to the end of the first day, when they become quiet again; and this motion, though least in the largest ovules, and most in the smallest granules, is generally from one side to the other in all, like that of a zoospore which is attached to the glass by one of its cilia, or of a monad, which possesses a polymorphic coat attached to some body, and a moving single cilium. Some of the granules, however, every now and then appear to break away from this attachment, and then present a single (?) ciliary appendage, which ceases to be visible again the moment they become fixed. All the ovules, both those with which a granule is connected, and those without, appear to undergo a like granulation of their internal contents, and pass into new sponge-cells, which for a day or two remain polymorphic and reptant, and then assume a spherical actinophorous form; while there is also a development of single (?) ciliated monads, closely resembling those

* Ann. & Mag. Nat. Hist. loc. cit.

which are found in the fully developed sponge. In their retant state, also, the former present the vesicula, and frequently a single cilium.

Under what circumstances we are to view the incorporation of this granule with the sponge-ovule I am ignorant. Certain it is, that one of these granules, which at first hardly appear to differ from the ovule itself, except in size, and the addition, perhaps, of a single cilium, may frequently be seen to exhibit movements about a large ovule indicative of a desire to become incorporated with it; and frequently, also, it succeeds, before the eye, in fixing itself permanently to its circumference; while occasionally a monociliated granule may be seen to be appended to one of the sponge-cells thus newly developed, in the same manner as the "zoosperm" attaches itself to similar cells in the old sponge.

In the absence, then, of direct evidence respecting the ultimate destination of these bodies, we must infer that they are germs, which grow into new individuals (perhaps like microgonidia),* or that they are impregnating agents, which enter into the ovules, and thus render them capable of further development, or both. Analogy, in connection with the facts mentioned, seems to favour the latter view; for when we observe the development of the ovules, and these spheroidal or discoid segments of the granulated nucleus, which are about the same diameter as the ovules, occurring together in the same *Euglypha*; and one cell, viz. that of the ovule, remaining entire, while the contents of the other, viz. the spheroidal segment of the nucleus, has apparently divided up into a number of locomotive granules, the process so far accords with what takes place in higher organic developments during the act of generation that we become much induced to extend the analogy still further, and consider that the contents of some of the spermatozoid granules or smaller cells go into this larger one to complete it, in the families of Rhizopoda, &c. mentioned. The monociliated cells ("zoospores")† of *Spongilla* might, perhaps, by some be considered young sponge-cells, which lose their cilium on further development; for such is the course with the monads which are produced from the rhizopodous cells of the protoplasm of the Characeæ before they pass into *Amœbae*; while the number of the former being as great in the first portion of sponge which issues from the capsule as in the older mass, if not more so, seems not only to support this view, but also that they do not form part of the surface-layer of the canals in which cilia have been detected by Mr. Bowerbank, for at this period there are no canals present.

* See Braun on the reproduction of *Hydrodictyon*.—Ray. Soc. Pub. Bot. & Phys. Mem. pp. 261 et seqq.

† Ann. & Mag. Nat. Hist. vol. xiv. p. 334.

The facts above mentioned, however, are opposed to this view; for there is a marked difference between the reptant sponge-cells produced from the ovules in the watch-glass, and the monociliated ones developed from the granules, both in size and appearance; and although the cilium subsequently seen in the former may have pre-existed in the ovule, still, both being polymorphic, rhizopodous cells, and, therefore, when united undistinguishable individually, the cilium might belong to either, *i. e.* to the sponge-cell or to the incorporated granule,—the latter of which may frequently be verified when examining a piece of *Spongilla* torn to pieces, under the microscope. Whether or not, however, both possess a cilium at first, the sponge-cell loses it afterwards, whatever may happen to that of the supposed zoosperm, which may not become incorporated with one; and this may be the case with the monads which are produced from the rhizopodous cell of the Characeæ,—there may be two kinds.

Should it be hereafter proved that the granules of the nucleus thus become impregnating agents, then this mode of generation may perhaps be extended through *Euglena* to *Navicula*, *Closterium*, *Spirogyra*, *Edogonium*, and *Cladophora*; for in none of these Algae has anything approaching to a process of generation been detected beyond conjugation and the formation of the spore; while, indeed, in *Spirogyra mirabilis* (Hass.), *Edogonium*, and *Cladophora*, the spore is formed without conjugation.—Might not the granulation of the nucleus, &c. go on in the spore?

In *Cladophora* the gonicimic substance consists of nucleated cells, each containing a portion of green chlorophyll-bearing protoplasm, and these are arranged in the way of a pavement on the inner side of the cell; hence we must consider *Cladophora* a composite Alga, which would then form the first step to the cell of *Nitella*, in which the green chlorophyll-bearing cells would correspond to the same kind of organisms in the cell of *Cladophora*; but as the form of *Nitella* is more complicated, so it requires distinct organs of reproduction for its general development. That the conjectured mode of generation mentioned in the freshwater Rhizopoda may be the same as in the lower Algae, and that the addition of other and distinct organs for this purpose in the higher developments is a necessary sequence of their complication, are observations merely put forth for what they may prove worth. At the same time, it appears evident that each organ must have its proper cell, and this cell its proper mode of impregnative reproduction, just as much as the most complicated beings of which it forms a part; while the granulating of the nucleus of a cell to furnish

for the process of generation, when a simple division of

it is only required for common reproduction, is perhaps not the least untenable view that may be held on the subject.

Development of the Ovule.—In *Spongilla* and *Euglypha*, this appears to take place by the passing of the transparent, faint-yellow film, which lines the interior of the capsule, into an opaque, yellowish, granular membrane; synchronously with which it becomes more marginated towards the capsule, and presents, in the centre, a pellucid area, in the middle of which, again, is a minute granule or body, which appears to be the rudiment of the nucleus. Frequently, also, another layer, as before stated, is seen in the ovules of *Spongilla* external to the capsular one, and this appears to be endowed with locomotive power, as it generally presents a parabolical shape, extended out from one side of the ovule; after which the ovule in each becomes transformed, apparently wholly, into a polymorphic, reptant rhizopod. The same process, modified, appears to take place in the ovules of *Euglena*. Thus in *E. deses*, where they are of an oblong shape (and therefore unmistakeable, if nothing but a legion of this species pregnant with ovules be present), they are found like the ovules of *Spongilla*, viz. scattered over the sides of the vessel, and evidently have, in like manner, the power of locomotion in addition to that which both also possess of turning upon their long axis when otherwise stationary. This, perhaps, may be partly effected by the external membrane just mentioned. The pellucid central area in the oblong ovules of *E. deses* corresponds with the oblong shape of the capsule; but beyond this, and the central granule, I have not been able to follow their development out of the parent; though, from the number of young *E. deses* which present themselves under the circumstances mentioned, it may reasonably be inferred that they come from the ovules. The young *Euglenæ*, however, being so rapid in their movements when once the cilium is formed, it can hardly be expected that, except under a state of incarceration, their development can be followed so satisfactorily as that of the slow-moving rhizopod. Instances do occur, however, where the ovule gain the cilium within the cell, and there bound about, when fully developed, like the zoospores of Algae within their spore-capsules. In this way I have seen them moving rapidly within the effete transparent capsuled body of *E. deses*, and in *Crumenula texta*, where the spiral fibre layer is so strongly developed as to retain the form of the *Euglena* for a long time after all the soft parts have perished. On these occasions the embryos are perfectly colourless, with the exception of a central point, which reflects a red tint; and on one occasion, while watching a litter in rapid motion within the capsuled body of *E. deses*, the capsule gave

way, and they came out one after another just as zoospores escape from the spore-capsule ; but from their incessant and vigorous movement I was unable to follow them long enough to make out anything more about them. Kœlliker also noticed in *Euglena* "four to six embryos in one individual, and entirely filling it, which at last, furnished with their red point and cilia, broke through their parent, leaving it an empty case."* The same kind of development of the ovule probably takes place in all the Rhizopoda as in *Spongilla*, and in that of *Astasia* as in *Euglena*. I have seen young *Astasiae* in an effete body of an old one, but could not say that the latter was the parent.

To Stein's original and valuable observations on the development of embryos, arising from the division of the nucleus in *Vorticellæ*, I have already alluded ; and also to M. Jules Haime's statements regarding the ovules which he saw in the bodies of *Plæsonia*, *Dileptus*, and *Paramecium aurelia*. Neither, however, appears to have seen ovules in either of these infusoria sufficiently distinct to describe their composition in detail.

Lastly, I would advert here to the rhizopodous forms which *Vorticella* occasionally appears to assume when under gemmiparous reproduction. Stein has described it in *Acineta*, and I have since observed it in a rhizopod undistinguishable from *Amœba diffusa* ; I have also seen *Vorticella* developed singly from *Acineta* ; and am now compelled to return to the conclusion which I doubted formerly, viz. that the rhizopodous development which takes place in *Euglena* is a similar passage of the nucleus, and perhaps certain other contents of this infusorium, into a rhizopodous form.† This appears to be as general in the family of *Euglena* as in that of *Vorticella* ; and although these two organisms at first look very different, yet, not only is their metamorphosis into rhizopodous forms similar, but the sudden contractile movement at intervals of a species of *Glenodinium* (Ehr., very nearly the same as *G. tabulatum*) is so like that of *Vorticella*, and *Glenodinium* so closely allied to *Euglena*, that we cannot help seeing in this act

* Qy. Jl. Microscop. Sc. vol. i. p. 34.—1853.

† This was the original view I took of it. I then conceived it to be a foreign development, like the rhizopodous cell of the Characeæ, for it took place in several *Crumenulae*, which had respectively been enwrapped for a short time in rhizopodous cells, when I thought the germs of the new development might have been introduced into them. Still I wavered in my opinion, as may be seen in the latter part of my description of this (Ann. & Mag. Nat. Hist. vol. xvii. p. 115), and since then I have returned to the old view, which is that above expressed ; for independently of other evidence in favour of it, *Euglena* would be an exception to what now seems to be a general occurrence in organisms closely allied to it, that is, if we considered this granular metamorphosis of the nucleus into polymorphic, rhizopodous bodies, a foreign development.

alone a feature which links together *Euglena* and *Vorticella*,—if not also, with other points of resemblance, the biphorous Tunicata or Salpidae.

Hence then, as *Vorticella* may pass into *Acineta* or *Ameba*, and *Euglena* also into a rhizopodous cell, and the former may in its metamorphosis produce young *Vorticellæ*, so perhaps *Euglenæ* may produce young *Euglenæ* after a similar manner.

How, then, are we to regard this granulating development of the nucleus? We have seen that it occurs in *Euglypha*, where also there is a distinct development of ovules. Are we to regard it as the flowering of a dioecious male plant, or as the budding of a monoecious or bisexual flowering one,—as the impregnating element, or as a reproductive gemmiparous one? We can hardly consider it budding or gemmiparous, because it is a development of the nucleus itself, which allies it more to fissiparous or duplicative sub-division; and if this cannot be determined, perhaps it had better be called “granulation.” Gemmæ grow out from the surface, and do not appear to contain any portion of the nucleus (*ex. gr. Vorticellæ*); neither could I discover an elongated nucleus, as Stein has figured, in the *Amebae* and *Acinetæ* which I saw developing young *Vorticellæ*, the former in plurality (one to three), and the latter singly; if present in the amoebous form, it was circular, and if in the *Acinetæ*, undistinguishable from the general “granulation.”

Again,—where are these transformations to end? Into what kind of rhizopods do the sheathed *Vorticellæ* pass? How many of the freshwater Rhizopoda are alternating forms of *Vorticella*? How many actinophorous rhizopods those of *Euglenæ*? &c. are questions originating in Stein’s important discovery, which not only indicate the necessity of further investigation, but a considerable approaching change in this part of the classification of infusoria.

It is desirable, also, that I should add here what little more I have been able to collect respecting the development of the monads in the rhizopodous cell, which dwells and multiplies in the protoplasm of the Characeæ.* This, it will be remembered, I conjectured to be by segmentation of parts of the diaphane and sarcode; but before making any further observations on the subject here, I will again premise a brief description of this cell. It is distinctly a rhizopod, like *Ameba diffluens*, or the sponge-cell, but of greater tenuity, and without, so far as my observation extends, a vesicula; that is, I have not been able to recognise this organ in it, though on dying it presents vacuoles. The nucleus, as before stated, is clear at first, then becomes cloudy, and presents one or more defined granules; afterwards semi-granular, and

* Ann. & Mag. Nat. Hist. vols. xvi. xvii. pp. 108 and 115, respectively.

opaque, and then uniformly granular throughout, when it appears to multiply by fissiparation in the parent cell, and thus to give rise to several daughter-cells, after the manner of a vegetable cytoplasm; or to grow into an elongated granular body, of whose ultimate development, while within the living internode of the Characeæ, I am ignorant. But when the internode of *Nitella* (*ex. gr.*) is about to die, and this rhizopod seizes upon the green discs of the periphery and other nutritious matters of the interior, now deprived of the vitality which kept them together and thus exposed to the rapacity of the ascendant parasite, the nucleus undergoes various changes, which arrests of development at different stages, among the myriads which are presented to view, seem to elucidate. Thus the nucleus and its capsule, now surrounded by the nutritive contents enclosed within the sarcode, enlarges and passes from its discoid form (elliptical in the large *Nitella*) into a globular one: * meanwhile the former becomes distinctly and uniformly granular; the granules enlarge, and become refractive; they assume, *en masse*, a spheroidal form enclosed within a cell of their own, and thus become distinct from the capsule; at the same time one or more refractive (oil?) globules, or a nucleolus, may sometimes be seen in the latter. While this is going on, a zone of colourless plasma (?) forms all round the capsule of the nucleus, which thus becomes separated from contact with the now hardened cell-wall or pellicula, as well as from the diaphane and sarcode. The next stage is the bursting of the proper cell, and passage of the granules of the nucleus into its capsule, and from thence into the soft plasmic zone which surrounds it. After this, the plasma assumes a mulberry shape, and divides up into monads, which feed upon the enclosed nutritive matters, and are at length seen in the position of the sarcode and diaphane, now circumscribed by a transparent delicate membrane, the second pellicular cyst.† That the refractive granules of the nucleus, and portions of the enclosed nutritive contents, which are coloured brown by the dead chlorophyll, get into the bodies of the monads cannot be doubted, as such matters are seen in them, and could come from no other source. Frequently, however, cells

* I must infer this, because the nuclei in the large species of *Nitella*, as well as in *Chara verticillata*, are all elliptical.

† Is this degenerated pellicula and diaphane or a new cyst, composed of the former only? I am now inclined to the latter theory, here as well as in *Otosoma* (Ann. & Mag. Nat. Hist. vol. xvii. pp. 108 & 118 respectively), and that in *Otosoma*, the ciliated coat is divided up for the new litter, while in the rhizopodous cell of the Characeæ the diaphane and secreting organ of the pellicular cysts perish or pass

may be seen, apparently under an arrest of development, where the plasmic zone has assumed a sub-tuberculated or mulberry form, and the granules of the nucleus are still in their globular cell within the capsule ; hence it may be inferred that the segmentation of the plasma commences before the granules of the nucleus get into it. Again, in a more advanced but still arrested stage, the capsule of the nucleus is seen to be empty, and its bright granules, in the little pouches or mulberry-shaped excrescences of the plasma, now reduced to a mere membrane by arrest of development. From which it may also be inferred that each pouch, which represents a monad, receives one or more of the granules of the nucleus. Does the tuberculated or mulberry surface of the plasmic zone, thus under an arrest of development, indicate that it has taken this shape from consisting originally of a number of ovules enclosed within a globular membrane ; and if so, is the passage of the granules of the nucleus into them to be considered an act of impregnation ? If they were ovules, then one would think that there would be no occasion to lay up extraneous nutrition for them more than *Euglypha* or *Spongilla*, &c. has need to lay up for their ovules, which, after the parent perishes, remain for a certain time in the effete body, and ultimately undergo a kind of incubation, generally after they have left the cavity in which they were developed. Again, though very much like the granulating of the nucleus in *Euglypha* and *Amoeba*, where the bodies which are thus evolved singly or in groups generally become endowed with active locomotive power before they leave the parent; yet in these instances no plasmic zone around the nucleus preparatory to this has been observed.* In the present stage of our knowledge, therefore, we are not able to say whether this be a gemmiparous or a generative process ; whether monads developed in this way are merely multiplied zoospores of this organism, or the mixed product of a genuine generative process ; whether there be, in addition, an ovular development, as in *Euglypha*, &c. ; or whether the monads thus developed soon perish, or become new cells. Certainly in *Spongilla* there are two kinds of developments, viz. the so-called zoospores or monads, and the transformation of the ovule directly into the sponge-cell : both are polymorphic, and at first have each (?) a single cilium ; but one being much smaller than the other, they may perhaps be regarded respectively macrogonidia and microgonidia, as Braun has suggested for the zoospores of *Hydrodictyon*.† From whence, then, come the so-called zoospores in the latter—from the granules of the nucleus ?

* *Actinophrys oculata* (Stein), however, presents a nucleus and plasmic zone of this kind. (See p. 454.)

† Ray. Soc. Pub. Bot. & Phys. Mem. loc. cit.

Lastly, there are two organs in those *Euglenæ* (*mihi*, which for no just reason Dujardin has separated from this family), viz. *Phacus* (Ehr.) and *Crumenula texta* (Duj.), that I should notice here, though I am perfectly ignorant of their use. These are the so-called "red spot," which in *Crumenula texta*, where it is comparatively very large, rests in the form of a small obtuse cone upon the vesicula; and the glary capsuled body, which always exists in the centre of *Phacus*, and in the long lip of *Crumenula texta*, &c.;—in some *Euglenæ* there is an undefined yellowish body here.

Of what use the "red spot" or body may be I am ignorant; but it is very common to see matter like that of which it is composed multiplied throughout the body of *Euglena*, both in an amorphous and molecular form; and when nothing but the ovules remain in the colourless, transparent, fibrous cells of the two species mentioned,—to see little granules of it moving with a more than Brownonian motion among the ovules. Ehrenberg regarded it as the rudiment of a visual organ; and perhaps he is right, for there seems to be very little difference between the pigment of the skin of a Negro and the pigment of the choroid membrane of his eye, while the latter is confined to the eye alone in white-skinned people. Again, in some of the Rotifera, it is not uncommon to see the material of which the red pigment of the eye is composed, more or less dispersed in a molecular form, though it is generally confronted by a bluish refractive matter, corresponding, perhaps, to the vitreous humour and lens. Also, in the so-called blind *Planaria*, there are organs like eyes with flat corneæ, but no pigment; and when the animal is about to divide into two across the stomach, the first indication appears to be an inversion of the integument which is to form the future eye, and at the same time a covering of it with cuticle, which thus supplies the cornea. Finally, then, as we find in the Albino eyes capable of seeing without the presence of pigment; the eye formed by an induplication of the skin; the pigment dispersed over the body, as well as in the eye, in the Negro, while it is confined to the eye in the white races, we are led to the conclusion that the red body in the family of *Euglena*, though not necessarily indicating sight, may nevertheless mark the point where something of this nature exists in this, as well as in other infusoria of the kind, although, as in *Astasia*, it is not similarly marked any more than in many animals wherein a visual organ is present without this accompaniment.

In a small species of *Euglena*, which dwells in the brackish water of the main-drain of Bombay, and which, after having been placed in fresh water, assumes the still, protococcus form, multiplying itself by fissiparation and internal segmentation of the sarcode, after the

manner of vegetable cells, and occasionally in linear arrangement, like the filamentous Algae, the red body is as often omitted as repeated in each cell; while in the active state, previous to *longitudinal* deduplication, the red body always becomes dual, one on each side the vesicula. But in transverse fission it is frequently absent in the lower half, and only remains in the longitudinal divisions of the *anterior* one. It is interesting, too, to observe that this body is present in the gonidia of *Ulothrix zonata*, one of the filamentous Algae, and that it also is confined to the first cell in fissiparation, which so far corresponds with *Euglena*, that when the latter assumes a fixed or alloid form, by capsulation, the peduncle of the pellicula is extended from the anterior, ciliated extremity. This also is the part which develops the root-like prolongations in *Oedogonium*; and probably the gonidia of *Ulothrix* grow after the same manner; when the red body would remain in the inferior half, and not be repeated, as in *Euglena*, when the latter fissiparates, in the still form, transversely.

With reference to the single, glary, capsuled body which exists in the centre of *Phacus*, and in the large lip of *Crumenula texta*, also dually in *Euglena geniculata* (Duj., *spirogyra* Ehr.), one on each side the nucleus, I can state nothing further than that in the two first it consists of a discoid transparent capsule, which at an early stage appears to be filled with a refractive, oily-looking matter; that it is fixed in a particular position, and remains there apparently unaltered, with the exception of becoming nucleated, until every part of the animalcule has perished, and nothing is left but the spiral-fibre coat, and perhaps a few ovules. In *Euglena geniculata* it is baccilliform, and contains a correspondingly shaped nucleus; and although I can state nothing respecting its uses, I cannot fail to see that it has an interesting analogy, particularly in the latter instance, with two similar organs, which are commonly seen in the *Navicula*, and which in *N. flava ex. gr.* are situated in a variable position, between the nucleus and the extremities on either side. In this species they make their appearance as little specks, generally previous to the development of the oil-globules, &c. and enlarging rapidly, assume a globular form, which consists of a transparent capsule, enclosing a glary, refractive, oily-looking fluid. As the starch and oil-globules are developed and subside, these glary globules become distinctly nucleated, sometimes irregular in form, or pedicled to the endochrome-bearing protoplasm, and, like their apparent analogue in *Crumenula*, &c. remain in the frustule when everything else has become decomposed, or has passed into minute brown-red granules (sporules?), when they present a central, glary, circular nucleus, surrounded by a double globular capsule, neither of

which, like the globule in *Crumenula*, takes any colouring from a solution of iodine. I need not here go further into the description of this organ in *Navicula*: suffice it to say, that it also appears constantly in a large species of *Amphiphora* common in the brackish water of the main-drain of Bombay, where it assumes the form, when fully developed, of an elliptical body, terminated at each end by a compressed, truncated, or obtuse elongation, like a barrel, and is always attached to the circumference of a vesicle. I should not have written so much about this organ here, but as it is not (as generally, I think, supposed to be) a common oil-globule, and we know so little of the organology of the *Diatomeæ*, while its occurrence in *Navicula* seems to add to the other points of alliance which exist between the *Diatomeæ* and *Eugleneæ*, its mention may not prove useless or uninteresting to those who are engaged in these studies.

Here I should not omit to add that the resting-spore or macrogonidium (Braun) of *Edogonium* develops a number of capsules like the ovules of *Euglena*; and that though they occasionally exhibit, under the action of iodine, a blue tint, indicative of their amylaceous nature, yet when fresh, and newly formed, they only take the brown-yellow one invariably presented by the ovules of *Euglena* under the same circumstances. Similar colourless capsules may also be seen moving about cells of *Edogonium* whose contents have left their walls, and appear to have partially progressed towards that of the spore, without having had strength to assume the globular form; and these very much resemble the ovules of *Crumenula* when moving by the aid of a cilium within the effete transparent cell. All must allow, from what I have stated respecting the cell-contents of *Edogonium flavescens* (Kg.), viz. that under favourable conditions, when the cell is broken, they can leave it bodily, form into a spore, and swim about by aid of their cilia, and that the germs of *Edogonium* can pierce the sheath of *Oscillaria princeps* (Kg.), and germinate between its cells, are phenomena of a kind much more common to the animal than to the vegetable kingdom.

In conclusion, I have only to remark that the reader is requested to view all speculative suggestions in this summary of my "Notes" as mere cursory observations, introduced for the purpose of calling attention to subjects which are deemed worthy of consideration; the study of this part of organic creation being so much in its infancy, and so intricate, that hardly anything but that which has received ocular demonstration should be taken for *fact*.

ART. VI.—*Further Observations on the Ruined City of Brahminabad, in Sind.* By A. F. BELLASIS Esq., Bombay Civil Service.

Read April, 1856.

SINCE March 1854, when I first commenced to excavate amid the ruins of Brahminabad, I have visited the ancient city on three several occasions. In these rough notes I purpose to mention the result of my researches, and, without entering into much detail, I proceed to describe any discoveries of special interest.

On the occasion of our second visit, we selected for excavation a heap of ruins adjoining the site of the house first excavated, and standing on the verge of the same bazar. The house was built of burnt brick, and the rooms of similar construction to those before described. Among the first things of interest found were some very curiously carved stone slabs, raised about five inches from the ground, on four feet. They were carved out of a solid block of stone, but, with one exception, were all more or less broken into pieces by the weight of the walls that had fallen upon them. I was, however, successful in finding all the pieces of some of them, so that the whole could be put together. They varied in size from two to two and a half feet square.

The most beautiful was one of red sandstone, similar to that now found at Porebunder in Kutch. The slab is square, with a large circular space in the centre, the corner pieces being ornamented with peacocks and snakes. This circular space is slightly depressed, for the retention of water, and on one of the sides of the slab is a bull's head, with the water escape passing through the bull's mouth. In this specimen the four corner feet were panelled, and exquisitely carved with bass-relief figures, two on each foot. Two feet were wanting, but on the two found the figures were, a lion on one panel, and on the other a warrior armed with sword and shield. On the other foot are two female figures, one playing the Surindah, a kind of guitar still in use. The other female appears to be admiring herself in a looking-glass, which she holds in one hand, while with the other she is dressing her

hair. These feet are connected with each other by a cornice of open tracery of great beauty, running along the sides of the slab, and the whole forming a beautiful specimen of carving.

The figures, and all the emblems and ornaments used, are Hindoo, such as are seen on old Jain temples. One remarkable fact is that the figures carved on this slab are quite perfect, and have not been mutilated by any iconoclast.

The followers of the Prophet were such zealous image-breakers, that in their invasions and conquests they rarely failed to mutilate every idol they saw. Among the Kafir Kotes near Jerruck, where some Buddhist remains were found highly ornamented with figures, not one escaped defacement,—even on a cornice, where the figure of Buddh was repeated again and again, the chisel of the iconoclast had taken the trouble to deface every head. It may therefore be inferred, from finding these figures entire, that Hindooism was still paramount in Brahminabad at the time of its destruction by an earthquake, and that the tide of M^uhammedan invasion had either barely reached so far into Sind, or that the conquest was far from complete; and this is an incidental coincidence which accords with history.

I found many other slabs of the same kind, but none so richly carved; they were all found buried very deep in the ruins, and near the lower floors. Their use was evidently connected with religious worship. They may have been probably used by the Hindoos of Brahminabad to place their idols upon, and to perform the ceremonies of their ablutions; but, strange to say, although I made careful search, I found no idol. It has been suggested, that these idols were their household gods, their Penates, and these would be the very first things the inhabitants would endeavour to save.

Among many other curious articles found, four lumps of clay, with the proof impressions of a number of seals, deserve mention. The seal engraver, to whom these belonged, was evidently in the habit of keeping proofs of all the seals he engraved and sold, by taking their impressions in these lumps of fine clay. The characters and devices of the seals were quite fresh on the impressions, and there are as many as fifteen to twenty impressions on each lump of clay.

On the third occasion that Mr. Richardson and I visited Brahminabad, we excavated a house in the same bazar, but some little distance higher up, and were richly rewarded, by finding some beautifully carved figures in ivory. The largest is about four inches long,—a female standing figure, with a lotus in one hand; many of the other figures appear to be dancing-girls; the female with a looking-glass, on the slab above described, is again to be recognised, and also another warrior; an elephant, fully capa-

risoned ; and other figures, in all about fifteen figures. These also were in no way defaced by the hand of the iconoclast. From the manner in which they were found, all close together, I conclude that they were portions of a richly carved ivory box,—some appeared injured by fire. The ivory is much decomposed, and is very brittle, and, with pressure between the fingers, may be reduced to powder.

In this same house we were further repaid by finding nearly a complete set of ivory chessmen, one set white, the other black. The kings and queens are about three inches high, and the pawns about one ; the other pieces of different intermediate heights. All have been made for use on a board with holes, for each piece has a peg in it, similar to chessmen used now-a-days on board ship, to prevent the pieces being easily knocked down, and the game disturbed. The ivory of these too is in a very decayed state, and very brittle; every particle of animal matter seemed completely exhausted, and the ivory reduced to a substance not unlike lime or chalk. Dice were also found,—some square cubes of ivory, numbered exactly as dice used at the present day ; others, the long dice, used by the Natives to play the game of Punchweshee. The discovery of these chessmen is a curious fact : they are probably the oldest known set in existence, and tend to confirm Sir William Jones' assertion that chess was a game of Brahminical origin.

The *Encyclopædia Britannica* gives the following account of the history of the game :—

“With regard to the origin of the game of chess we are much in the dark. Though it came to us from the Saracens, it is by no means probable that they were the original inventors of it. According to some it was invented by the celebrated Grecian hero Diomedes. Others say that two Grecian brothers, Ledo and Tyrrheno, were the inventors ; and that being much pressed with hunger, they sought to alleviate the pain by this amusement. According to Mr. Irwin, it is a game of Chinese invention. During his residence in India he found that a tradition of this nature existed among the Brahmins, with whom he frequently played the game. But according to Sir William Jones, this game is of Hindoo invention. ‘If evidence were required to prove this fact,’ says he,* ‘we may be satisfied with the testimony of the Persians, who, though as much inclined as other nations to appropriate the ingenious inventions of a foreign people, unanimously agree that the game was imported from the west of India in the sixth century of

* *Asiatic Researches*, vol. ii. mem. ix.

our era. It seems to have been immemorially known in *Hindostan* by the name of *Chetorangá*, i. e. the four *angs*, or members of an army; which are these,—*elephants, horses, chariots, and foot soldiers*; and in this sense the word is frequently used by epic poets in their description of real armies. By a natural corruption of the pure Sanscrit word, it was changed by the old Persians into *Chetrang*; but the Arabs, who soon after took possession of the country, had neither the initial nor final letter of that word in their alphabet, and consequently altered it further into *Shetranj*, which found its way presently into the modern *Persian*, and at length into the dialects of India, where the true derivation of the name is known only to the learned. Thus has a very significant word in the sacred language of the Brahmins been transformed by successive changes into *axidrez, scacchi, échecs, chess*, and, by a whimsical concurrence of circumstances, has given birth to the English word *check*, and even a name to the *Exchequer* of Great Britain.”

We also found the remains of an inlaid tortoise-shell or ebony box. I at first thought it was^t the chess-board, as it was found in the same house as the chessmen, although in a different room; but I could find none of its numerous pieces with a hole fitting the pegs of the chessmen. It had been an elaborate piece of inlaid workmanship. Some of the fragments are circular, others oblong, others triangular; some with a border pattern cut upon them, others with open carved work; and I think a careful examination of the pieces will show that the box was inlaid in ivory, ebony, and tortoise-shell, and perhaps with other materials.

I have had accurate drawings taken of most of these relics, of the carvings on the slabs, of the ivory figures, of the ivory chessmen, &c. &c., and these I have sent, with the originals, to Lieutenant Colonel Sykes, F.R.A.S., at the East India House.

Pottery, glass, glazed-ware, &c. were found in great variety and abundance, as described in my first paper on Brahminabad; also copper coins, cornelians, and cornelian chips; onyxes, agates, beads, women's bangles of glass, of ivory, and of brass. Bones and teeth, both of men and of animals, were abundant in every house. In one was found the head of a rat; in others, the bones of fowls; and the teeth of camels, oxen, and horses were very common. Beyond a few engraved seals, I found nothing with any inscriptions.

On the fourth occasion we determined to excavate in quite a different part of the city. We selected a very large mound of ruins near to the standing tower, supposed to be the site of King Dolora's palace; but

here we were not so fortunate, as we found nothing of special interest. I do not think we excavated sufficiently deep to reach the foundation. The walls of this house were far more substantially built, and the apartments of larger dimensions. Some of the walls, three and four feet in thickness, were to be seen thrown out of the perpendicular, as if by the rude shock of an earthquake. In this building more lime than usual was found, and the face of one wall had been plastered with lime.

Respecting the cornelian ornaments found figured with patterns in white lines, on a perfectly smooth surface, and which I thought were so curious in my first paper, I have made further inquiry; and while at Sehwan, in Upper Sind, an old city famed for cornelian engravers, I found some stones figured in exactly a similar manner. On examination, it was ascertained that the chief ingredients used were potash, white lead, and the juice of the Kirar bush (*Capparis aphylla*), made into a thick liquid, and applied with a pen on the cornelian, which, on being exposed to a red heat in charcoal, rendered the device indelible.

On my last visit to Brahminabad, I made inquiry of an old cultivator if he had ever seen any of the round solid balls of pottery mentioned in my first paper. "Saheb," rejoined the old man, "come to the Toph Khana (arsenal), and I will show you plenty." I followed his guidance, and he led me outside the city walls, and across the dry bed of the river, and there, in the plain, sure enough were a number of these pottery balls. I could distinctly see the square heaps, in which they had been piled in regular rows like round shot; and, scattered over the plain, numbers of single ones were to be found, slightly embedded in the soil. They were of various sizes, some as large as 12-pounders, others about the size of billiard balls. The old man accounted for there being so many scattered about the plain by saying that in ancient times a great battle had been fought on that spot. The smaller balls might have been used in a sling, but the larger ones would have required some engine like the balista to propel them.

Besides Brahminabad, there are the remains of several other cities on or near the supposed ancient course of the river Indus. Besides those mentioned in my former paper, Captain Kirby has discovered one near Roree, of great extent; and I also saw the ruins of a small town near Soofee, on the Narra, fourteen miles west of Omercote, when travelling between Meerpoor and Omercote.

Captain Kirby's account, which is very interesting, I give entire:—

"In excavating the great Narra Canal, at a distance of about two miles and a half from the town of Roree, we occasionally came upon

detached masses of brick-work, and at length, at a depth of about ten feet below the surface of the ground, the foundations of a very large number of houses were laid bare. These foundations consisted of stone, or of mingled stone and brick-work, and resembled those to be seen in the ruins of the city of Arore at the present day, where it will be observed that the foundations of the houses are generally built of stone to a height of two or three feet above the ground, and the walls which rest on this foundation are composed of mud or unburnt bricks.

" In one instance the earth in the centre, and also outside the walls of one of the foundations I have mentioned as having been discovered ten feet below the surface of the ground, was removed, and the walls left standing : they then appeared to be those of a house, containing one room about sixteen feet in length by ten in breadth, and two smaller ones about ten feet by six. At another place, where the canal had been excavated to a depth of about twelve feet below the surface of the ground, a circle of stone-work was observed, between three and four feet in diameter. The earth was removed out of the centre to a depth of about two feet, and after taking out two or three broken vessels of brick-work, a crowbar penetrated several feet lower down without meeting with any resistance ; unfortunately the water immediately rose to the surface, and prevented, for the time, any further excavation.

" In proceeding from the direction of Roree, the first of these ruins which we came upon were those of a large wall of considerable height, about four feet in breadth, extending from one side about a hundred feet into the canal, and built of extremely good and well burnt bricks. This wall has been hitherto excavated to a depth of about twelve feet. It may probably have formed a portion of the walls of the town, as I am not aware of any ruins of houses having been discovered on the northern side of it. From this point towards the south-east, the foundations of houses extend about seventeen hundred feet along the bed of the canal. Amongst these ruins were found a number of articles made of brick-clay, such as drinking cups, a Khoоза, some water-spouts, and a large number of children's toys.

" There were also found some round stones, which have all the appearance of having been used as weights. I did not find any which exactly corresponded with the seer of the present day, but they almost all did with the chittak :* for instance one stone was exactly two chittaks, another four, a third six, and so on.

" It appears that the town was built on the extremity of a rocky hill, and that it has been gradually covered by the mud held in suspension

* An Indian weight of 900 grs. Troy, or little more than 2 oz.

by the flood-waters of the Indus, which even now flow over the spot ; indeed its burial-ground, which (according to the common custom in this part of Sind) was high up upon the rocky hill, is still uncovered.

"The name of the place, it appears, was Hukrah, a name still retained by a village in the neighbourhood ; and it is, according to the Natives of the country, mentioned by a prophet of the Mamooee caste of Fakkeers, who says,—

• When broken shall be the bund of Arore,
And the water shall flow over Hukrah,
Where will be the fishing of the Summah ?

"Probably with the idea that when the bund of Arore was broken, and the waters flowed over Hukrah, the river Indus would have taken that course, and left its present bed dry. The bund of Arore, however, is not yet broken, nor is there much chance of its being so, as it has been lately repaired, partly with the bricks which were removed out of its old neighbour, the town of Hukrah, when excavating the channel for the canal.

(Signed) "J. H. KIRBY, Captain,

"Arore, 17th August 1855." H. M. 86th Regiment."

This city, which appears to have been built of pucca brick and stone, and to have been fortified, is in its general characteristics like those of Brahminabad, &c., but quite unlike any cities now inhabited in Sind, which are all built of unburnt brick and mud. It however differs in this respect, that although it was built on a rocky hill, it is subject to be inundated by the floods from the Indus, and has been buried gradually by the silt held in suspension by the flood-waters ; whereas the ruins of Brahminabad and the other cities are all above ground, and have no signs of having been inundated.

It has been suggested, that the finding of these cities built with burnt brick and stone, in a country where these materials are no longer used, is evidence of a great climatic change. It has been said that "in nearly rainless districts, such as Sind, Egypt, and part of Beloochistan have long been, the expensive operation of burning bricks never thought of where it can be dispensed with ; and we are fully warranted to infer that a thousand years ago, when a precaution was found indispensable which is now superfluous, Sind was blessed with regular falls of rain."

—(Bombay Times.)

I shall now conclude these observations with an account of Brahminabad by Captain F. J. Goldsmid, of the Madras Army, who was employed in Sind, and whose intimate knowledge of Persian gave him

many opportunities of consulting Persian books and MSS. After reading my first paper on Brahminabad, he drew up the annexed memorandum, which I give in an appendix, as it contains many additional particulars relating to the history of the city.

APPENDIX.

Memorandum on Diloo Raee and Bhambro or Brahminabad. By Captain F. J. GOLDSMID, Madras Army.

It is by no means easy to form a complete chronological chain of events from the various links supplied by Native chroniclers. Want of accordance, of intelligibility, of the information most essential,—these are serious drawbacks to satisfactory and uniform workmanship. The following few notes may be useful in drawing conclusions as to recent discoveries; they are from the same source whence the Syuds of Tatta derive their historical knowledge. Sabir Ali Shah is himself the lineal descendant of the author of the "Toohfut-ool-Kiram." The Chuchnama contains the name of Brahminabad frequently. It was a bone of royal contention to the Hindoo dynasty, which included the Sehreses and their sons. The Ayeen Akbaree refers to it as the ancient capital of the territory known in after years as the Sirar Tatta. It is therein described to have been once a very populous city, containing a fort of 1,400 bastions, a tenab distant from each other. Considerable vestiges of the fortifications were extant in A. D. 1600, in the reign of Akbar.

2. There are two Diloo Raecs in early Sindian history, and the dominion ascribed to each proves that the Moslem conquest of Sind was far from complete for the first three or four generations after the invasion of Mahomed Kassim in A. D. 711.

3. The first bearing the name is met with in the account of the Lieutenants of the Baree Oomya,* whose respective reigns may be thus adverted to:—

1st.—Ahruf bin Dais. He held Alore. The Hindoos revolted after the second year of his government, and the country from Debalpoor (Tatta) to the sea remained in the hands of the Moslems.

2nd.—Aboo Hife.

3rd.—Tanreem bin Tiab.

* Toohfut-ool-Kiram, vol. iii.

- 4th.—Amr bin Abdoola.
 5th.—Amr bin Mussallim.
 6th.—Suliman bin Asham.
 7th.—Abool Kittah.

This period is from 93 to 133 Hijree, during which there appears to have been also in Sind a king named Diloo Raee, of the race formerly dominant, who lived in Diloor, so called after his own name. It may be natural to suppose that the revolt above alluded to was but a renewal of the struggle on the part of the vanquished Hindoos, with a view of ousting the invaders, whom they succeeded in driving to the borders of the sea.

4. During the same period of forty years, there is mention made of a second Hindoo king, named Bhamboo Raee, the founder of Bamboor, in connection with whose reign is introduced the tale of Sassoee and Punhoo. Now, if the locality given to the legend be that of the city in question, the Hindoos must at the time of its foundation have re-possessed nearly the whole country.* “It is situated on the right of the road from Wuttejee to Gharra.” Lieutenant Burton adds: “The town is supposed to have been built upon the plain, and was destroyed by divine wrath in one night, in consequence of the ruler’s sins”; thus identifying it with the Bhamboora on the opposite bank, the subject of these notes.

5. In the account of the Lieutenants of the Banee Abbas,† we hear of fresh armies and fresh conquests. It is related that one of these Chiefs, Moossa, “restored all that he took,” or was “as generous as successful”; and received his dismissal from head quarters in consequence. The inference would be, that extension of territory was a grand aim of the Moslems in those days; nor could this well be denied by any true believer, the object being synonymous with extension of the faith.

6. During this government (Banee Abbas), and probably at some period in the fourth century of the Hijree, or indeed the date mentioned in the paper on Brahminabad (*ante. p. 416*), it was found desirable to strengthen the Arab tenure in Sind by an additional number of settlers. The Banee Tameen and the men of Saumra ‡ were the most famous

* Burton’s Sind Note 25, page 380.

† Toohfut-ul-Kiram, vol. iii.

‡ Mr. Bird’s Memo., drawn up from Mahomed Masoom’s history, and Dewan Muta Mill on this subject; for Dr. Burnes shows that the Soomras derived their name from Tanimrah, on the Tigris. But he makes Diloo Raee, and Chota, Soomras themselves. If the former were, however, a member of the old Hindoo royal stock, one could hardly transfer his Brahminical thread to the neck of a flesh-eating Arab, even in imagination.

of these. From the latter spring the Soomras, who eventually ruled the land. During this emigration we learn that Chota Amranee, brother to Diloo Raee II., lent his aid to the cause by proceeding to Bagdad, and returning with a hundred Arab followers. But the narrative of his importation of a wife is the more important to elucidate the present question, and is related in the Toohfut-ool-Kiram as follows:—

"They say that Diloo Raee, after the destruction of Alore, came to reside at Brahminabad. He had a brother by name Chota Amranee, son of Amr.* The Almighty had converted him in youth to the blessings of Islam. He had left the city, and learnt the Koran by heart, also the usages of Mahomedanism, in the most approved fashion. On his return, his friends wished him to marry: some one said jestingly on the occasion, 'Let this renegade go to the Kooba, and wed with the daughter of such and such a famous Arab.' By good luck, and his brother being then young, he determined to go on a pilgrimage. When he arrived at his destination, he saw a woman at a shop, busy reading aloud the Koran. He stood to listen. The reader said, 'Why are you standing there?' 'To hear the Koran' he replied: 'if you will kindly teach me the various readings I will be your slave.' The woman said, 'My teacher is such a one, the daughter of such a one: if you will change your clothes, and put on a maiden's vesture, I will take you to her.' He consented, and was shortly in the damsel's presence. She was skilled, among other accomplishments, in astrology. One day the woman who had introduced Chota asked some questions from her regarding her own daughter's marriage. When the reply had been duly communicated, Chota said, 'Since you know the state of others, assuredly you are acquainted with your own.' The damsel replied,—'It is well remembered; you have now looked into your own destiny.' She added, 'I am to be united to a man from Sind.' He asked, 'When?' She answered, 'Soon.' He continued, 'Where is the man?' She consulted her tables, and replied, 'You are the man.' When the veil had thus been removed from Chota's destiny, the expounder of the Koran said, 'Begone, and come no longer in the guise of another. Take off these clothes, appear as yourself, and seek my hand, for I am destined to be yours.' Then, after acquainting her parents, she became the bride of Chota. The latter returned to Sind, and took the beautiful Fatima with him. When he reached the city of Diloo Raee, that tyrant had established a custom that all newly mar-

* Mr. Bird's Chota is descended from Oomra Soomra. It should be noted that the family designation here is Amranee, of the house of Amr, one being written with an Aileen, the other an Alif.

ried women should in the first instance be brought to him. Chota went to his brother, and sought to dissuade him from so infamous a practice; but all argument proved vain. At length, one day, when Chota was absent from home, the king proceeded to his brother's house. He had heard much in praise of Fatima, and longed to see her. But intelligence of the occurrence was quickly conveyed to the husband, who returned to watch his brother's actions in secret. Convinced of the baseness of the tyrant's purpose, he rushed from his hiding-place, rescued his young and virtuous wife from the grasp of her tempter, and instantly quitted the city. A voice said, 'This city is about to be swallowed up by the earth, owing to the wickedness of its ruler.' • Let him save himself who takes due warning.' A few obeyed, and were watchful. The first night the city was spared, by the wakefulness of an old woman at a wheel; the second by means of an oil-presser; the third night the city went headlong into the earth,—only one minaret was left, as an example."

7. In supposing the date of the destruction of Brahminabad to accord with the epoch inferred by the Tatta Syud, I should remark that Mahomed of Ghisne annexed Sind to his dominions in about 1025. It is not at all likely that this conqueror would have left standing so powerful a subject as King Diloo Raee, whose territory extended from Brahminabad even up to Dhera Ghazee Khan and Seelpoor; for the children of Saif-ool-Mulek, the merchant, and his wife Badeea-ooz-Zemain (whose treatment by Diloo Raee was cause of the ruin of Alore) are said to have been buried in the above locality "in the king's dominions." If Syud Ali Moosooce, then, accompanied Chota on his return from Bagdad in 1020, the destruction of the city may be supposed to have almost immediately followed their arrival in Sind.

ART. VII.—*Researches and Discoveries in Assyria and Babylonia.* By Sir H. C. RAWLINSON, K.C.B., K.L.S., &c.

July 1855.

COLONEL RAWLINSON having been solicited to communicate to the meeting a brief description, *verbis roce*, of the results of recent discovery in Assyria and Babylonia, proceeded to comply with the request. He pointed out, however, at the commencement of his address, that the subject was too large to be handled with effect within the limit of time allowed to him; that it was impossible to follow out an inquiry which involved the restoration of the history of Western Asia from the Patriarchal ages to the time of Cyrus in a single hour's discussion—and that he should therefore confine himself to the mere heads of the arguments in general matters; reserving all particular description for those salient points where cuneiform research came in contact with scripture history, and where the means were thus afforded of illustrating and verifying the inspired writings of the Jews.

He exhibited on the table a collection of antiquities, which he had lately obtained in Chaldea, Assyria, and Babylonia, and which he was now conveying to England for deposit in the British Museum. They were arranged in three different classes, and were intended to illustrate three distinct periods of history. The most ancient class was Chaldean; the second was Assyrian; and the third was Babylonian. The Chaldean class consisted of relics found at the primitive capitals of Southern Chaldea, which are now represented by the ruins of *Mugheir* (Ur of the Chaldees), of *Warkâ* (Erech of Genesis), of *Senkereh* (Ellasar of Genesis), of *Niffer* (Accad) and the neighbouring sites. Among the relics were stamps of the cuneiform legends impressed on the bricks of the ancient palaces and temples, a number of inscribed cones of baked clay, and a small tablet of black marble, bearing a well-preserved legend in the ancient hieratic character; and the period to which the relics belonged was stated to extend from about the twentieth to the thirteenth century B.C. In proof of such antiquity, Colonel

Rawlinson referred to the brick legends of one of the Chaldean kings, *Ismi-Dagon* by name, and showed that by a series of dates, fortunately preserved upon the Assyrian monuments, the interval between this monarch and Sennacherib was determined to be above 1150 years, so that the former king must have ascended the throne of Chaldea in the early part of the nineteenth century B. C. But *Ismi-Dagon* was not the first monarch of his line. Relics had been obtained of several of his predecessors, one of whom was named *Kudur-Mapula*, "the ravager of Syria," and it was pointed out that this epithet naturally suggested an identity with the Chedorlaomer of scripture. The latter form indeed seemed to be a corruption of *Kuddur-el-Amar*, or "Kudur the Red," and to refer to the king's Semitic nationality, a conflict of races at that time having pervaded the East, and the Scythian or Cushite aborigines being termed "the black," while the Semitic invaders were distinguished as "the red." It was not thought necessary to follow the primitive Chaldean line in any detail, as the names were throughout unknown in history; but it was stated that a list had been obtained of above twenty of these monarchs from the various ruins on the lower Tigris and Euphrates, and hopes were held out that, as materials accumulated, all the names might be classified and connected, if not in a genealogical series, at any rate in a dynastic succession.

It was next explained that the second class of relics, consisting for the most part of tablets of "terra cotta," belonged to the Assyrian period, which extended from the thirteenth century B. C. to the capture of Nineveh in about B. C. 625, and that to this chronological division belonged all those specimens of Assyrian art which had recently attracted the admiration of Europe. There seemed no reason to doubt but that, during the long period of Chaldean supremacy, Assyria occupied a very subordinate place in the civil polity of the East. The primeval rulers of the country, whose names had been found impressed in rude characters on the bricks of the earliest Northern Capital (now called *Kileh Shergat*), had never assumed the regal title; nor among the territorial epithets, which the Chaldean monarchs catalogued on their monuments, was the expression "King of Assyria" to be met with. Works of art anterior to the thirteenth century B. C. were absolutely unknown upon the upper Tigris, and the inference therefore seemed to be that, although the Assyrians had imported from Chaldea in the very earliest times the use of letters and the rudiments of civilization, the country had not attained to any political consequence, until the Southern Monarchy had ceased to exist. At the same time it was not probable that the Assyrians, like

the Persians of a later age, had made a sudden stride from dependence to universal dominion. Of the early kings little had been preserved beyond the names; but we had fortunately the detailed annals of a monarch, named Tiglath-Pileser (the first), who ascended the throne at least 150 years after the foundation of the monarchy, and even at that late period Babylonia had not become subject to Assyria. On the contrary, *Merodach-adan-akhi*, the king of Babylonia, contemporary with Tiglath-Pileser I., had, in about B. C. 1110_y, attained a great victory over the armies of Nineveh, and had carried off the Assyrian gods as trophies to Babylon;—but the Assyrian arms, although checked to the south, had already penetrated to the north far beyond the range of Taurus, and to the west to the shores of the Mediterranean. The most interesting result, indeed, which was obtained from the annals of Tiglath-Pileser I., was the light thrown by that monarch's wars in Syria and Asia Minor on the ethnographical distribution of Western Asia in the twelfth century B. C. It appeared at that time that Northern Syria and the great plateau of Anatolia were peopled by Scythian nations, while Southern Syria was dependent upon Egypt (the Casluchim or Khasmonians, who, according to scripture, were the ancestors of the Philistines, being the dominant tribe), and the Aramaean stock was confined to the valleys of the Tigris and Euphrates. The Jews must have been then living under the rule of the Judges, and were probably confounded by the Assyrians with the other scattered Semite colonies, who acknowledged the Khasmonian supremacy.

The most brilliant period of Jewish history—that is, the age of David and Solomon—unfortunately admitted of no illustration from the Assyrian annals. The contemporary monarchs of Nineveh were occupied with the building of cities and the adorment of their palaces and temples, or with expeditions among the northern mountains, but they were hardly yet strong enough to provoke a contest with the organized armies of the kings of Syria. It was at the commencement of the ninth century B. C., shortly after the building of Samaria, that the Assyrians first undertook the subjugation of the countries on the Mediterranean; and from that period to the extinction of the empire, the annals of Nineveh, running in a parallel line with Jewish history, presented a series of notices, which established in the most conclusive manner the authenticity of the Hebrew scriptures. The geographical names which occurred in the Bible were also found in the inscriptions. The names of the kings of Israel and Judah, of Damascus and of Nineveh, were given in the two independent accounts under the same forms, in the same order of succession, and with the same chronological relations.

The same events even were described, with that mere variation of colouring which was due to national feeling.

In the earliest expedition into Syria of this period, that undertaken by *Asshur-uchur-bal*, the builder of the North-West Palace at Nimrod, early in the ninth century B. C., the Assyrians did not come in direct contact with the Jews, though they overran the whole country as far south as Damascus, and even exacted tribute from the maritime cities of Phœnicia. The succeeding king, *Silima-rish*, fought several battles with Ben Hadad, and, after the dethronement of the latter, with the usurper Hazael, while he also received rich presents from Jehu, who is called in the inscriptions the son of Omri from having sat on the throne of Samaria. The annals of the next king, *Shamaaphul*, extended but to four years, during which the wars of the Assyrians were confined to Asia Minor and Babylonia; and of his successor, *Phulukh*, (the *Pul* of scripture and Φαλωχ of the LXX., no strictly historical record had been yet found. The interesting fact, however, had been discovered that this king married a foreign princess of the name of *Summuramit* (or Semiramis), and that, having lost his throne by a domestic revolution to a stranger of the name of Tiglath-Pileser (the second), the upper royal line of Assyria, after a dynastic rule of 526 years, terminated in his person—all this minutely agreeing with the fragments of Assyrian history preserved to us by the Greeks. From the death or dethronement of *Pul* commenced the second or lower Assyrian line, the epoch being marked in Babylonian history as the era of Nabonassor, and dating from B. C. 747. Of Tiglath-Pileser, the first king of the lower dynasty, annals had been found extending to his seventeenth year, and among his tributaries were many names which were of interest from scriptural association, such as Menahem of Samaria, Rezin of Damascus, Hiram of Tyre, the Kings of Byblos, of Casius, of Carchemish, of Hamath, and even a Queen of the Arabs, who seemed to have reigned in Idumea, or Arabia Petraea, and who is the representative in regard to race and station of the famous Queen of Sheba, who had visited Solomon about two and a half centuries before.

According to scripture history Tiglath-Pileser must have been succeeded by Shalmaneser, a name which had not yet been found in the inscriptions, but which had originally headed, it was believed, certain mutilated tablets recording the wars of an Assyrian monarch with Hoshea (?) king of Samaria, and with a son of Rezin of Damascus. It seemed probable that as Tiglath-Pileser II. had defaced the monuments of *Pul*, whom he supplanted, so Sargon, who was again of a different lineage and who gained the throne of Nineveh in B. C. 721, had designedly mutilated the records of Tiglath-Pileser and Shalmaneser,

who were his two immediate predecessors, no single slab belonging to these kings having been ever found, either in a perfect state or in its original position. The explanation offered of this period of history was that Shalmaneser had succeeded his father, Tiglath-Pileser, on the throne of Nineveh about B. C. 728,—that he laid siege to Samaria in 724-23, and while engaged in that operation was surprised by the revolt of Sargon, who ultimately drove him from power and established himself in his place in B. C. 721. Sargon's first act was to bring the siege of Samaria to a close, and the account of the Samaritan captivity given in the inscriptions corresponded closely with that preserved in scripture. Halah, Habor, indeed, and the river of Gozan, where the ex-patriated tribes were placed, and which had been so variously identified by geographers, were proved by the inscriptions to be represented by the modern *Nimrud*, and by the two rivers, the *Khaboor* and the *Mygdonius*, the latter Greek term being a mere participial formation of Gozan, which was the original Assyrian name of the city of *Nisibin*. The annals of Sargon were preserved in great detail, and were replete with notices of much historical interest. His wars were described, with Merodach Baladan, the king of Babylon, with the kings of Ashdod, of Gaza, of Hamath, of Carchemish, and of many other Syrian cities. He received tribute from Pharaoh of Egypt, from the Queen of the Arabs, and her confederate the chief of Sheba (or the Sabaeans who at that period dwelt in Edom). There was a distinct account, moreover, of the expedition to Cyprus (which was referred by the Greeks to Shalmaneser); and Sargon's memorial tablet had been discovered in the Island. The history of Western Asia, indeed, at the close of the eighth century B. C., was given in the most elaborate detail in the inscriptions of Khorsabad, which was Sargon's capital, and in every respect was found to coincide with the contemporary annals of the Jews. Verifications of still more importance had followed from the discovery of the annals of Sennacherib, who succeeded his father Sargon in B. C. 702. His wars with Iluketus of Sidon, and with Merodach Baladan and his sons, were in near accordance with the notices of the Greeks, and the famous Assyrian expedition, which Sennacherib led against Hezekiah of Jerusalem, as given in the native annals, coincided in all essential points (even to the numbers of the thirty talents of gold which the Jewish king paid as a peace-offering) with the scriptural record of the event. It was not to be expected that the monarch of Assyria would deliberately chronicle his discomfiture under the walls of Jerusalem and his disastrous retreat to Nineveh; but there was the significant admission in his annals that he did not succeed in capturing the Jewish capital, and this was sufficient to attest the interposition of a miraculous power.

The annals again of Esar Haddon, who ascended the throne on the death of his father, in about B. C. 680, were of almost equal interest. He warred in Phoenicia, in Syria, in Asia Minor, and Armenia, in Media, in Susiana, and in Babylonia. He sent a Queen from his own household to rule over the Arabs of Edom. He must have led a great expedition into Africa, for he assumed the distinctive title of "Conqueror of Egypt and Æthiopia." Finally he obtained the aid of Manasseh, king of Judea, together with that of most of the other kings of Syria, in constructing a magnificent palace at Calah, of which building the ruins are still to be seen at the south-west corner of the great mound of Nimrud.

The son of Esar Haddon, who was named *Asshur-bani-bal*, but who was almost unknown to the Greeks, had left numerous monuments and of great value. Mr. Layard had excavated, some years ago, a portion of one of this king's palaces at Nineveh, but recently a far more perfect and more highly finished building of the same king had been discovered in another part of the mound of *Koyunjik*. The sculptures in this palace were of the very highest class of Assyrian art. The hunting scenes, indeed, represented on the walls of some of the chambers, were perfectly beautiful both in design and execution, and a very large selection of these had been made for the Assyrian gallery in the British Museum. In illustration of this branch of the subject some figures of dogs in "terra cotta" were exhibited, which had been discovered in a cavity of the wall on removing the slabs which formed the wainscoting. They were models apparently of the favourite lion-hounds of the king, the figures being painted of different colours, and having other distinctive marks, while the name of each dog, generally a descriptive epithet, had been stamped or incised upon the clay.

The most valuable relics however of the time of *Asshur-bani-bal* were stated to be the inscribed clay tablets of baked clay forming portions of the Royal Library. The number of these tablets already exhumed could not be less than 10,000, and they appeared to embrace every branch of science known to the ancient Assyrians. They were especially valuable in affording explanations of the Assyrian system of writing, one class of them, unfortunately rarely met with, but of which a specimen was exhibited at the table, showing how the original pictorial figures had been degraded to characters, while others contained tables expressing the different syllabic values which were attached to each character, and a third class again presented elaborate lists of all the simple and compound ideographs of the language with their phonetic equivalents. Even with the important help of these explanatory tables the work of decipherment had proceeded slowly, and many

difficulties still remained to be overcome ; but without their aid, it was observed, the inscriptions would have continued to the present time to be for the most part unintelligible.

It was now left for Colonel Rawlinson to refer to the Babylonian period of history, and to invite the meeting to examine the highly important and original relics of this period, which were laid out upon the table. The last king of Nineveh, *Asshur-ebid-ilut*, of whom nothing remained but a few bricks with half obliterated legends, had been probably dispossessed of his throne by the united armies of the Medes and Babylonians in about B. C. 625. Nabopolassar, who either sent or led the expedition against Nineveh, became from this period the lord paramount of Western Asia. The seat of his empire was at Babylon, which he strengthened and partially rebuilt. Many tablets had been found dating from different periods of his reign, but there was no autographic record, either of his domestic works, or of his foreign conquests. It was to his son Nebuchadnezzar, who succeeded him in B. C. 606, and who reigned for forty-four years, that most of the Babylonian relics belonged, which now filled the museums of Europe. A very interesting discovery had been recently made in regard to a building erected by this monarch, the particulars of which were described as follows :—

A remarkable ruin, named *Birs Nimrud*, and situated on a mound in the vicinity of Babylon, had long been an object of curiosity to all travellers and antiquaries. The great height of the mound, its prodigious extent, and its state of tolerable preservation, contrasting so favourably with the shapeless heaps in the neighbourhood, had very generally suggested the identity of the ruin with the temple of Belus, so minutely described by Herodotus, and as there were large vitrified masses of brickwork on the summit of the mound, which presented the appearance of having been subjected to the influence of intense heat, conjectures that the *Birs* might even represent the ruins of the tower of Babel, destroyed by lightning from heaven, had been not unfrequently hazarded and believed. To resolve the many interesting questions connected with this ruin, Colonel Rawlinson undertook, last autumn, its systematic examination. Experimental trenches were opened in vertical lines from the summit to the base, and wherever walls were met with they were laid bare by horizontal galleries being run along them. After two months of preliminary excavation, Colonel Rawlinson visited the works, and, profiting by the experience acquired in his previous researches, he was able in the course of half an hour's examination to detect the spots where the commemorative records were deposited, and to extract, to the utter astonishment of the

Arabs, from concealed cavities in the walls, the two large inscribed cylinders of baked clay which were exhibited to the meeting, and which were now in as fine a state of preservation as when they were deposited in their hiding place by Nebuchadnezzar above twenty-five centuries ago. From these cylinders it appeared that the temple had been originally built by the king *Merodach-adan-akhi* at the close of the twelfth century B.C., and probably in celebration of his victory over *Tiglath-Pileser I.*; that it had subsequently fallen into ruin, and had been in consequence subjected to a thorough repair by Nebuchadnezzar in about B.C. 580. The curious fact was further elicited, that it was named the "Temple of the Seven Spheres," and that it had been laid out in conformity with the Chaldean Planetary system, seven stages being erected one above the other according to the order of the seven planets, and their stages being coloured after the hue of the planets to which they were respectively dedicated. Thus the lower stage belonging to Saturn was black; the second sacred to Jupiter was orange; the third or that of Mars was red; the fourth of the Sun, golden; the fifth of Venus, white; the sixth of Mercury, blue; and the seventh of the Moon, a silvery green. In several cases these colours were still clearly to be distinguished, the appropriate hue being obtained by the quality and burning of the bricks, and it was thus ascertained that the vitrified masses at the summit were the result of design and not of accident—the sixth stage sacred to Mercury having been subjected to an intense and prolonged fire, in order to produce the blue slag colour, which was emblematic of that planet. It further appeared, that we were indebted to this peculiarity of construction for the preservation of the monument, when so many of its sister temples had utterly perished, the blue slag cap at the summit of the pile resisting the action of the weather, and holding together the lower stages, which would otherwise have crumbled, while it also afforded an immovable pedestal for the upper stage and for the shrine which probably crowned the pile. The only other point of interest which was ascertained from the cylinders was that the temple in question did not belong to Babylon, but to the neighbouring city of Borsippa, the title of *Birs* by which it is now known being a mere abbreviation of the ancient name of the city.

Colonel Rawlinson now adverted to the famous slab of Nebuchadnezzar which is deposited in the Museum of the India House; and he stated that it contained a description of the various works executed by Nebuchadnezzar at Babylon and Borsippa, which so nearly corresponded with the account of Berossus quoted by Josephus, that it would hardly be doubted the Chaldee historian had consulted the original

autographic record ; and here was introduced the notice of a most remarkable passage of the India House inscription, which seemed to contain the official version adopted by the king of that terrible calamity that overtook him in the midst of his career. Abruptly breaking off from the narrative of the architectural decoration of Babylon, the inscription denounced the Chaldean astrologers ; the king's heart was hardened against them ; he would grant no benefactions for religious purposes ; he intermitted the worship of Merodach, and put an end to the sacrifice of victims ; he laboured under the effects of enchantment (?). There is much that is extremely obscure in this episodical fragment, but it really seemed to allude to the temporary insanity of the monarch, and at its close, when the spell was broken which had been cast over him, the thread of the argument, having reference to the building of Babylon, was resumed. There was a passing allusion in this inscription to the Western conquests of Nebuchadnezzar, and in an amplified copy upon a clay cylinder, of which a fragment had also been found at the *Birs*, the subjugation of the countries on the Mediterranean was specifically mentioned ; but hitherto annals of the Babylonian monarchs, similar to those which were so carefully prepared in Assyria, had in no instance been discovered, and an independent account therefore of the capture of Jerusalem and the carrying away of the Jews into captivity was still among the desiderata of cuneiform science.

After a brief notice of Nebuchadnezzar's successors, *Evil Merodach* and *Nergal-shar-ezer* (*Neriglissar* of the Greeks), Colonel Rawlinson proceeded to explain his last discovery of importance, which established the fact of the eldest son of Nabonidus having been named *Bel-shar-ezer*, and that pointed the way to the reconciliation of Profane and Sacred History in regard to the capture of Babylon by *Cygnus*. Relics of Nabonidus, the last king of Babylon, abounded, not only at Babylon and Borsippa, but in Southern Chaldea also. From the ruins of a temple to "the Moon," which had been recently excavated at "Ur of the Chaldees," four perfect cylinders of this king had been recovered, which were now placed on the table, together with the fragments of a hollow barrel cylinder of the same period. The latter relic contained a detailed account of the various works of Nabonidus throughout the empire, and was particularly valuable in mentioning the monarchs who founded and repaired the temples in the different capitals, and in establishing their chronological succession. The four smaller cylinders, which all bore the same inscription, referred particularly to the history of the temple of "the Moon" at Ur of the Chaldees. In both legends the architectural description was finished

with a special prayer and invocation for the welfare of the king's eldest son *Bel-shar-ezer*; and as this substitution of the name of the king's son for that of the king himself was an isolated example and totally at variance with ancient usage, the only reasonable explanation of it seemed to be that *Bel-shar-ezer* (abbreviated in Daniel to *Belshazzar*, as *Nergal-shar-ezer* was shortened by the Greeks to *Neriglissar*) had been raised by the king during his lifetime to a participation in the imperial dignity. On this supposition then—that there were two kings reigning at the same time in Babylon,—it could well be understood that Nabonidus, the father, may have met the Persians in the open field, and after his defeat may have thrown himself into the stronghold of Borsippa as stated by Berossus; while Belshazzar, the son, may have awaited the attack of the enemy in Babylon, and have fallen under that awful visitation of the divine vengeance which is described in the Book of Daniel. That the eldest son of Nabonidus, indeed, who is distinctly named *Bel-shar-ezer* in the cylinders of *Mugheir*, could not have survived the extinction of the empire is rendered certain by the fact that when a revolt of the Babylonians took place at the commencement of the reign of Darius Hystaspes, the impostor who personated the heir to the kingdom and called his countrymen to arms, assumed the name of "Nabukudruchur, the son of Nabunit" (see inscription of Behistun), the rights of the eldest son having descended to the second. As the cylinders exhibited to the meeting were the only solitary documents on which the name of Belshazzar had been ever found, apart from the pages of Daniel, they were objects of special interest, and would no doubt be reckoned among the choicest treasures of the British Museum.

Colonel Rawlinson had not at present in his charge any relics of a later period, though he stated that tablets dated during the reigns of the Achaemenian monarchs from Cyrus to Darius Coddomanus, were by no means rare, and that he had even recently examined a number of cuneiform documents, consisting of benefactions to temples, which were dated under the reigns of Seleucus and Antiochus.

Among the miscellaneous articles exhibited were a number of signet cylinders, which were commonly used by the Babylonians as seals to authenticate official documents. All the benefaction tablets recently discovered were thus endorsed, having been impressed while the clay was soft. The legends however on the cylinders were of no consequence, merely consisting of the name of the owner, of that of his father, and of an epithet implying dependence on one of the numerous gods of the Pantheon. A black stone, bearing the symbols of the gods, and invoking their vengeance on any one who should alter or resume a certain grant of lands recorded in the document, was also on the table.

It was stated to be very similar to the relic usually known in Europe as "le caillon de Michaud," another mutilated specimen of the same class which was obtained from Babylon by Mr. Rich being already in the British Museum, and being in fact the identical stone with which some years ago the famous Portland vase was dashed to pieces. The only other object of interest was a small cube of ivory, bearing on it certain mathematical tables, which were inscribed however in a character so minute as to be almost invisible until examined with a strong magnifying glass, and it was suggested that from this specimen alone we might reasonably believe the Assyrians to have been in the habit of manufacturing lenses, and to have been thus considerably advanced in a knowledge of the science of optics!

Colonel Rawlinson having been further requested, by Dr. Wilson, to say a few words on the subject of the language of the inscriptions and the mode of decipherment, explained, that the first clue to the reading of the Assyrian character was obtained from the tri-lingual rock-tablets of Persia and especially from the autographic record of Darius Hystaspes at Behistun. As a translation in the Babylonian character and language, which nearly resembled the Assyrian, was appended to the original Persian edict at the latter place, the sense of the one being known, a sure basis was established for the analysis of the other. His comparison of the two versions of this inscription, and his preliminary researches into the grammar and etymological affinities of the language of ancient Babylon, had been published in the Journal of the Royal Asiatic Society some four years back, and as he had since that time studied and analyzed many thousand inscriptions, not mere rock legends of a few lines restricted to the formula of royal proclamation, but long elaborate histories, records of the chase, architectural reports, scientific treatises, prayers, invocations, and the whole arcana of the Chaldee religion and philosophy, he might now really claim a very extended acquaintance with the language. In all essential points the Babylonian was a mere primitive Hebrew—the roots were the same,—the grammatical construction perfectly analogous,—the conjugations very similar,—the names of objects for the most part identical. The radical difficulty in reading and understanding Babylonian and Assyrian lay in the extraordinary number of the characters employed (the phonetic signs alone exceeding 300); in their variant powers, one character being often used to express six or seven different syllabic sounds; and above all in the very general employment both of simple and compound ideographs, of which, although the meaning might be ascertained from the context, it was impossible to define the phonetic values without the aid of the explanatory tablets. From the

latter source he had now succeeded in tabulating between 3 and 4000 ideographs with their phonetic correspondents, but he did not consider this branch of the subject to be one half exhausted. His own impression was that there were at least 20,000 ideographs in common use, and he considered that until these were all determinately explained and read, no one could pretend to have thoroughly mastered the language. He was now proceeding to England in the hope that he might advance the work of decipherment, and should steadily pursue the inquiry through his future life.

Colonel Rawlinson, in conclusion, expressed his obligations to the Society for the aid which he had received from it in his early studies, and especially by its extensive library, to which he was under great obligations. He had peculiar satisfaction in appearing before it on this occasion, on observing the parties by whom he was surrounded. To a distinguished friend of his Lordship in the chair, bearing the honoured name of "Elphinstone," he was greatly indebted. That friend had received him on his first arrival in India, and had greatly encouraged him in his study of the eastern languages, to which any success which he had experienced was much to be ascribed.

- The Rev. DR. WILSON, Honorary President of the Society, rose for the purpose of moving that its best thanks be conveyed by the Patron of the Society, Lord Elphinstone, to Colonel Rawlinson, for his most able and interesting communications on this occasion; and that the Secretary should be directed to prepare a minute expressive of the regard which it cherishes for this distinguished member, whom it congratulates on the unparalleled success of his learned investigations. Colonel Rawlinson, he added, had expressed his obligations to the Society, and especially to its library, for the aid which they had furnished him in his lingual and historical studies. But these advantages must not be over-estimated. Without Colonel Rawlinson's peculiar talent in the acquisition of the oriental tongues, his readiness and acuteness of observation, and his patience and perseverance of research, they would have been of no avail in effecting the great results which had awakened the attention and secured the confidence of the scholars of Britain, France, Germany, and America, and which had excited the wonder and admiration of less competent judges throughout the world. He had certainly received no assistance from his contemporary members of the Society, except in the general sympathy which is common to them and intelligent observers everywhere to be found. It is to the honour of the Society, however, that Mr. Rich, one of its early members, who was much encouraged by the counsel of its founder, Sir James

Mackintosh, had taken the lead in Assyrian and Babylonian research, exploring the ruins of Babylon and Nineveh, and making large and valuable collections of their minor antiquities ; and that its Transactions contained an analysis and review by Mr. Bellino, another of its members, of the first *tentamina* for the decipherment of the cuneiform inscriptions of Dr. Grotefend and his predecessors ; and that Dr. Grotefend himself had duly informed it of his own discoveries, as from time to time they advanced. Colonel Rawlinson was the party to whom the praise was due of bringing all the researches on the cuneiform inscriptions of those who had preceded him to a fruitful issue, and of making such advances in this study as required the greatest effort of the most learned orientalists to follow him. Dr. Grotefend, by attending to the groupings of the wedges in the Persepolitan and adjacent inscriptions, had been able to point out the forms of distinct letters and their composition in words separated from one another by a slanting bar. The phonetic powers of some of the letters he had ascertained, by making trial of their application to the names of the Persian sovereigns. The meaning of a few titles attached to these sovereigns he had also ascertained. The distinguished linguist and archaeologist, Professor E. Burnouf, of Paris, whose death was so much and generally regretted, and Professor Lassen, of Bonn, one of the greatest orientalists and antiquaries of the present day, had greatly extended the knowledge of the ancient Persian alphabet, and made some of the cuneiform inscriptions intelligible, from their wonderful attainments in the Indo-Persic languages. But Colonel Rawlinson had accurately transcribed and published the tri-lingual inscriptions of Behistun, in the Persic, Babylonish, and Scythian cuneiform. He had completed the identification of all the letters of the Persian cuneiform, establishing the precise value of those formerly unknown or mistaken. He had translated the biography of the Achaemenian kings as recorded by themselves. From a comparison of the Persian inscriptions with those in the Babylonish character, he had ascertained the import of the latter, and prepared the way for the decipherment and translation of the Scythian inscriptions by Mr. Westergaard, and more particularly by Mr. Norris of the Royal Asiatic Society. He had found that the later Babylonish cuneiform letters were only a cursive corruption of the Assyrian cuneiform, and thus got the key to the Nineveh tablets, obelisks, and cylinders, the wondrous stories of which he had in substance unfolded to the world, awaiting a more particular literary exposition of them than public duty had yet permitted him to make. The most ancient Chaldean writings had not been able to baffle his ingenuity ; and the Society had witnessed, in the course of his familiar

address this day, how he was able to deal with them. His acquisition of antiquities at Nineveh and its adjacent sites reflected honour on the British nation, even after the success of Botta and Layard. What he had lately effected in Babylon and Chaldea, as illustrated by the interesting relics on the table, was most wonderful. It is impossible to over-estimate the importance of the researches in which he has been engaged, and in which he has been so successful. The great fact, that they went so far as they did to corroborate and illustrate the Hebrew scriptures, tended much to the confirmation and extended appreciation of those historical records which, originally written by the pen of inspiration, were so dear to all our hearts. The statement which he had made respecting the language of the most ancient Chaldean relics, even, was of the greatest importance. He (Dr. Wilson) conceived he could easily make by it an explanation of various Chaldeanisms in the earlier books of the bible, which by some incautious and unwary critics had been pointed to as neonisms, while, in fact, they are nothing but archaisms, such as would be used, especially in poetical pieces, by the family of Abraham, who was himself from Ur of the Chaldees. Colonel Rawlinson's researches, combinedly viewed, throw a flood of light on the history, art, science, and religion of the ancient world. Well worthy is he of all the honours which he has already received, and which doubtless await him in Europe, which he is about to visit.

Though the highest tribute of applause which this Society could extend to him was of small value, yet, as it was offered with sincerity and cordiality, it might be accepted.

Dr. Wilson's motion, having been seconded by Major General WADDINGTON, C.B., one of the Vice-Presidents of the Society, was unanimously and cordially adopted.

THE RIGHT HONORABLE LORD ELPHINSTONE, Patron of the Society, who presided on this occasion, stated that he had the greatest pleasure in conveying the thanks of the Society to Colonel Rawlinson in the terms of the motion now adopted, and of expressing his own thanks for the singular gratification afforded by his address that evening.

ART. VIII.—*On the Avesta, and the Zend and Pahlavi Languages.* By Professor SPIEGEL, in a Letter to the Rev. J. MURRAY MITCHELL, Bombay.

Read October 1855.

Erlangen, the 17th May 1855.

MY DEAR SIR,—I am extremely sorry that I have been compelled to defer so long the letter I promised to send you more than a year ago. My health, thank God, has been good all the while and is very likely to remain so, on this account I cannot answer for my prolonged silence. The fact is that I had made to you, in my last letter, a too rash promise which I could not fulfil before now. I had pledged myself to give you a short account of my studies in the Persian languages, and I was of the opinion then that I could do so within a few months. On nearer inspection, however, I perceived that my own studies would require more time than I first expected; and yet I was the more unwilling to break my former promise, as I hoped my results would be of some interest to you. Now, when I have completed a Pahlavi grammar and have a short history of Pahlavi literature nearly ready, I will not longer delay to answer your honoured letter of the 15th January.

* * * *

As you know, I was first induced to my promise by some remarks on the Persian languages by Mr. Romer, of which Mr. Romer did me the honour to transmit several copies, without, however, giving me his address. * * * * I shall not, however, enter on any discussion with Mr. Romer, owing to the difference of our principles. The rules of comparative grammar, which are laid down in the well-known works of Professor Bopp, he seems not to acknowledge; and yet they form the basis of the researches of M. Burnouf and Colonel Rawlinson as well as of my own. Laying therefore aside all polemical reasoning, I shall only endeavour to make my own views on the languages of Persia and their relations to each other as clear to you as it is possible

for me according to the present state of my researches.¹ I shall begin with the oldest of them—the old Persian or the Zend, as it is commonly called. All the Oriental scholars agree that there exists a close affinity between the old Persian, the Zend—or, as I am inclined to call it, according to M. Oppert's proposition, the old Bactrian—and the Sanskrit; and the only difference exists with reference to the antiquity of the old Bactrian. Professor Burnouf takes it to be a very old language, and maintains that not the language only but even the literary productions of the Pārsis in it belong to a time not so much later than that in which the language of the Vedas was spoken. Burnouf's opinion has been adopted by almost all the Continental scholars. Colonel Rawlinson, on the contrary, assures us that Burnouf's arguments have altogether failed to convince him of the close affinity between the Vedic Sanskrit and the old Bactrian, and he maintains that the Achæmenian dialect is the parent of the language of the Avesta. For my own part, although I do not deny that there are fragments of very old writings incorporated in the Avesta, I am inclined to side with Colonel Rawlinson in so far that I presume the Avesta to have been written down, as a whole, in a period much later than the reign of Xerxes or Darius. The comparative purity of the language is easily accounted for, for it is a well-known fact that language degenerates by long usage, and that literary pursuits have by no means a favourable influence on the language itself. Now the old Bactrians were, as Strabo testifies, but little better than Nomads, and therefore by no means a literary nation. The art of writing was entirely unknown, or at least very little used, in Bactria; in the old times, before the invasion of Alexander, all the literary compositions were retained by memory. In the Avesta itself writing is never mentioned, but it is always enjoined to keep the single parts of it in memory and to recite them. Therefore I think the Avesta must have been written down at a comparatively late period, after the invasion of Alexander.

If I differ, as you will perceive, with regard to the age of the Avesta, as a whole, from the greater part of the learned Orientalists, I do not deny that a good many parts of the book are old, and must have been current a considerable time before they were committed to writing. In many and essential points the precepts of the Avesta entirely agree with the manners and institutions of the old Persians as related to us by the classical writers. Only one must not expect that everything should be alike. The fatherland of the Avesta, as is generally believed for weighty reasons, is to be sought for in the neighbourhood of Bactria, and the difference of the country accounts for the difference of religious and

political institutions, even if these, taken as a whole, were nearly the same.

At what time and how these religious writings of the old Bactrians first extended their influence beyond their native boundaries, and were accepted as the sacred writings of the western part of Persia, I cannot tell, as we cannot derive even the feeble outlines of a history of the old Persian religion from contemporary and trustworthy sources. But it is a well-known fact, that the Avesta was generally accepted as a sacred work over the whole Persian empire in the time of the Sasanian kings. The old Bactrian language we just spoke of was by that time a dead language. We find that the Avesta has been translated into one of the languages of those times; and this language still exists and has formed the principal topic of my studies during the last two years. The Pahlavi language has been considered, as you well know, as a forgery by many learned men; and this opinion is not wholly without foundation, but certainly much exaggerated. That the identical language, which is found in the writings of the Pārsis, has really been in use for some time, cannot be doubted in our times. A large number of coins, which have been so assiduously collected and so skilfully explained by such men as Olshausen, Thomas, and Mordtmann, bear undoubtedly inscriptions in the same language in which the translation of the Avesta is written. The coins I mean are those of the later Sasanian kings. In the times of these kings, then, the Pahlavi language must have been a spoken language; and to these times I refer it. It might be objected, that the mixture with Arabic words, which are said to occur in the Pahlavi writings, is not likely to have taken place so early. But I must own that I never have been able to find out any Arabic word in the genuine old Pahlavi writings, viz. the translations of the Vendidad and the Yaçna. The Arabic words referred to by Richardson and others are taken from a small glossary printed in the second volume of Anquetil's translation of the Avesta. There, undoubtedly, many Arabic words are given us as Pahlavi words, but they were never used in Pahlavi literature, and have come even into this glossary by mere inadvertence. Anquetil wrote the said glossary from dictation of his teachers in three columns, first the Zend word, afterwards the Pahlavi, and lastly the meaning of the latter in Persian or Arabic. By mere inadvertence he has sometimes put the Persian or Arabic meaning in the place of the Pahlavi word itself, and to this circumstance alone the occurrence of Arabic words is to be attributed. In removing the Arabic words we remove at the same time the principal reason for doubting the authenticity and the age of the language. The similar

words which very frequently occur in Pahlavi belong to an Aramaic dialect, and that the Aramaic was spoken in the times of the Sasanian kings and understood by themselves is a well-known fact. Nor is it an argument against the authenticity of the Pahlavi, that the Iranian words in it, as well as the grammatical structure itself, are so very like to the Persian. A large number of Persian words, gleaned from the earlier Armenian authors, show satisfactorily enough that, so early as the third century of our era, the Persian language was nearly on the same level with the language of Firdosi.

But notwithstanding all this, I am not of the opinion that the Pahlavi language was ever spoken in the form we have it before us. Aramaic words could never be mixed in that manner in any living language. It is merely the language of books, and, as I suspect, the official style in the edicts of the later Sasanian kings. Aramaic words were then mixed with Persian even in a larger degree than in modern Persian or in the edicts of Turkish emperors.

We are not wholly without means to determine in what country this memorable language had its origin. I have quoted all the authorities at full length in my book; here I shall only give the results. The author of the *Fihrist-ul-Kutub*, a very valuable encyclopædia, which contains many extracts from early Mahomedan writers now lost to us, states, on the authority of Ibn Mokaffa (who has translated the *Fables* of Bidpai into Arabic, and was himself a convert from the Parsi religion to Islam), that the inhabitants of Sevâd (a country nearly coinciding with the modern Irak-arabi) used in their correspondence a kind of style where Persian and Syriac were mixed together. Ibn Mokaffa, as well as Parsi authorities, agree that the *Huzvaresh* (the name they commonly give to the language called by us the Pahlavi language) is used in the country of Sevâd. This country was inhabited by a mixed population, partly Persians, partly Nabatæans. (The Nabatæans spoke a corrupted Aramaic dialect.) Both languages, the Aramaic and the Persian, were therefore known to the people of that country; the Aramaic was, moreover, the medium by which the literary and commercial communications of Persia with the western provinces were maintained. The Aramaic literature was highly esteemed in Persia during the reign of the Sasanians, and the literature of the Nabatæans had a prominent share in it, as you can see from the excellent memoir inserted by M. Quatremère in the *Journal Asiatique* for 1835.

The statements I have just made are fully confirmed by the Pahlavi literature itself. The Semitic words of the Pahlavi not only belong to

the Aramaic tongue but also to the eastern branch of it (to which the Nabatæans belonged, according to the testimony of Barhebreus and other Syriac grammarians), that is to say, they made no discrimination between the single gutturals and several of the dentals. The translations of the Avesta belong to the same class of writings as the Aramaic Targums or the Philoxenian translation of the Bible. This fact I hope to establish beyond all doubt ; nor have we any right to be astonished at it, for the Persians, as you well know, were in the habit of visiting the Syriac Academy at Edessa and got all their learning from the Syrians.

After the downfall of the Sasanian empire, not only the old Persian religion declined, but the high authority of Aramaic learning also ceased, and was soon supplanted by the Arabic tongue and literature. The bulk of the Persian nation was converted to Islamism, and even the few Pârsis who remained in Persia forgot by degrees the spelling of the Aramaic words, and, only anxious to retain the signification of the word, they pronounced the Persian word instead of the Aramaic one. For instance, if they found written in their text the Aramaic word *lahma*, "bread," they pronounced *nân*, the Persian synonym for it. By this fact is explained how the Pârsis could ever forget the right spelling of the Aramaic words in Pahlavi. It is again Ibn Mokaffa who makes^s us aware of the proceeding just mentioned.

What I have stated to you here are merely the results of my studies in Pahlavi during the latter years. To quote the authorities on which they are based would exceed the compass of a letter ; I must refer you to the book itself, which will, as I hope, be published soon, and where you will find all the proofs.

The new work on the Pahlavi language and literature I just spoke to you of has enticed me for some time from other studies, and has delayed the completion of my edition and translation of the Avesta. Since it is finished, I am at work again. The whole of the Vîspêred and more than half of the Yaçna are ready for the press, both the text and the translation ; and I hope the second volume of the text and the translation will come out from the press in the beginning of next year. As to an English translation, I am not quite decided yet. My bookseller has declined to take part in the undertaking, and I think it would be indispensable, for many reasons, to have the work printed at Vienna. Besides, Mr. Westergaard, who has now completed his edition of the text, promises an English translation of it, and it is perhaps best to wait for it.

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ART. IX.—*Review of the Present State of Oriental, Anti-quarian, and Geographical Research connected with the West of India and the adjoining Countries.* By JOHN WILSON, D.D., F.R.S., Honorary President of the Society.

Read November 22nd, 1855.

THE first of our Asiatic Societies, and the model on which they are all constituted, was that of Bengal, formed in 1784, by the prince and pioneer of British orientalists, Sir William Jones. The happy idea of its institution occurred to him before he had planted his feet on these eastern shores. "When I was at sea last August," he said in his opening address, "on my voyage to this country, which I had long and ardently desired to visit, I found one evening, on inspecting the observations of the day, that India lay before us, and Persia on our left, whilst a breeze from Arabia blew nearly on our stern. A situation so pleasing in itself, and to me so new, could not fail to awaken a train of reflections in a mind which had early been accustomed to contemplate with delight the eventful histories and agreeable fictions of this eastern world. It gave me inexpressible pleasure to find myself in the midst of so noble an amphitheatre, almost encircled by the vast regions of Asia, which has ever been esteemed the nurse of sciences, the inventress of delightful and useful arts, the scene of glorious actions, fertile in the productions of human genius, abounding in natural wonders, and infinitely diversified in the forms of religion and government, in the laws, manners, customs, and languages, as well as in the features and complexions of men. I could not help remarking how important and extensive a field was yet unexplored, and how many solid advantages unimproved; and when I considered with pain that in this fluctuating, imperfect, and limited condition of life, such inquiries and improvements could only be made by the united efforts of many who are not easily brought, without some pressing inducement or strong impulse, to converge in a common point, I consoled myself with a hope, founded on opinions which it might have the appearance of flattery to mention,

that, if in any country or community such an union could be effected, it was among my countrymen in Bengal, with some of whom I already had, and with most was desirous of having the pleasure of being intimately acquainted." This distinguished man devised a wide sphere of observation and research for the Society which he thus projected. "It is your design, I conceive," he said, "to take an ample space for your learned investigations, bounding them only by the geographical limits of Asia; so that, considering Hindustan as a centre, and turning your eyes in idea to the north, you have on your right many important kingdoms in the eastern peninsula; the ancient and wonderful empire of China, with all her Tartarian dependencies; and that of Japan, with the cluster of precious islands, in which many singular curiosities have too long been concealed. Before you lies that prodigious chain of mountains which formerly, perhaps, were a barrier against the violence of the sea; and beyond them the very interesting country of Tibet, and the vast regions of Tartary, from which, as from the Trojan horse of the poets, have issued so many consummate warriors, whose domain has extended at least from the banks of the Ilissus to the mouths of the Ganges. On your left are the beautiful and celebrated provinces of Iran or Persia, the unmeasured and perhaps unmeasurable deserts of Arabia, and the once flourishing kingdom of Yemen, with the pleasant isles that the Arabs have subdued or colonised; and further westward the Asiatic dominions of the Turkish Sultans, whose moon seems approaching rapidly to its wane. By this great circumference the field of your useful researches will be enclosed; but since Egypt had unquestionably an old connection with this country, if not with China; since the language and literature of the Abyssinians bear a manifest affinity to those of Asia; since the Arabian arms prevailed along the African coast of the Mediterranean, and even erected a powerful dynasty on the continent of Europe, you may not be displeased occasionally to follow the streams of Asiatic learning a little beyond its natural boundary. And if it be necessary, or convenient, that a short name or epithet be given to our Society, in order to distinguish it in the world, that of ASIATIC appears both classical and proper, whether we consider the place or the object of the Institution, and preferable to Oriental, which is in truth a word merely relative, and though commonly used in Europe conveys no very distinct idea. If now it be asked, What are the intended objects of our inquiries within these spacious limits? we answer, Man and Nature; whatever is performed by the one or produced by the other."*

* *Asiatic Researches*, vol. i. pp. 9—13.

At the formation of our own Bombay Society in 1804, Sir James Mackintosh, its distinguished founder, took a more limited view of its intended operations ; but his desires in connection with it gradually expanded till they embraced the eastern world in all its amplitude, in so far as its varied regions and multifarious tribes and tongues and natural productions might fall under the observation of its members. Sir John Malcolm in 1812 strikingly expressed the peculiar advantages of our position, in Bombay for oriental research. "The field on which this Society has to labour, though it may appear small, will be found most productive. More approximated than any other part of British India to the shores of Arabia and Persia, and enjoying a more frequent intercourse with their inhabitants, the source of all knowledge connected with the Mahomedan religion and usages is more near and accessible. The borders of Gujarát and the deserts of Jaudhpur present most extraordinary races of men to your observation ; among whom many singular customs in their manners, if not in their worship, may be discovered ; and there is no place in India more favourable than this to the researches of the antiquarian and oriental scholar. The caves of Elephanta, of Salsette, of Kárla, and Ellora, are all in its vicinity ; and these, with the ruins of Ahmadábád and other cities of former celebrity in Gujarát, offer an inexhaustible source to the curious and learned inquirer. The city of Bombay itself (I here speak from experience) presents, from its numerous population and the various persons who resort to it from every quarter, a great store of information (to those that seek it) on almost all subjects connected with the history, geography, and actual condition of the different kingdoms of Asia. It is not only from its commercial prosperity that such persons resort to it, but from its being the port to which all the inhabitants of Arabia, Persia, Mekran, and part of Afghanistan, that visit India first come, as also that by which all pass that either go from India to these countries, or who proceed on a pilgrimage to Mecca, Kerbelah, or Nijif. In the whole course of my inquiries regarding the present state of the different provinces of Persia, Arabia, Afghanistan, Tartary, and even China, I have always been able to find a person in this city that was either a native of, or had visited the country regarding which I desired information. Independent of all these, the Gabars or Pársis (a complete account of whom is still a desideratum) are only to be met with in Bombay and its dependent provinces."*

To a great extent our Society has done justice to its position, though

* *Bombay Transactions*, vol. iii. Appendix.

the subjects which, in the progress of research, still demand its attention seem more numerous and extensive than ever. With the sister society in Bengal, and with the societies of more recent origin, but more extensive and able literary membership in England, France, and Germany, it has prosecuted with an encouraging degree of success the objects of its formation. The three quarto volumes of its Transactions, its considerable contributions to the Royal Asiatic Society of Great Britain and Ireland, and the four volumes of its own Journal, are highly valued, and have not been without their use in the general literature of our country. The distinctive and separate works of its members, published on individual responsibility, are of still higher interest and importance; and they are not to be dissociated from the Society in our estimate of its influence. By its library, the best in Asia, though it has still many obvious deficiencies even in those departments in which it should most excel, and by the generous fellowship and intercommunion and correspondence of its members, it has aided its associates both in their general culture and particular studies. It is our object at present briefly to note the research and authorship with which of late years it has been both directly and indirectly connected, and that principally with a view to our marking the subjects which now seem most to require our immediate notice in connection with the oriental research, and literary labour of those in other parts of the world with whom it is an honour for us to act as willing, though, it may be, humble, coadjutors. I leave the proceedings of nearly the first forty years of the Society at present out of view, for to these I have adverted in detail on former occasions.* The operations of the last twelve years are those in particular to which, for a few minutes, I would respectfully beg to direct the attention of the zealous and enlightened patron of the Society and the members who are present on this occasion.

I begin with the literature of the Zoroastrians. Sir John Malcolm's remark on the Pársis was made before the publication of his own important work on the History of Persia, and the valuable and able papers on the Pársis and their Sacred Books by Mr. Erskine, which appear in our Transactions. On leaving India in 1843 I took the liberty of dedicating to the office-bearers and members of the Society a work entitled, "The Pársi Religion: as contained in the Zand-Avastá, and propounded and defended by the Zoroastrians of India and Persia, Unfolded, Refuted, and Contrasted with Christianity." Though the

* See address to the Society, 27th January 1836, and Letter to the Secretary in the Journal of the Society, vol. i. pp. 234, et seq.

volume, from the circumstances in which it originated, it is to a great extent controversial in its form, I have had no reason to complain of the reception which it has experienced at the hands of our European orientalists. Its value in their eyes, whatever it has been, has doubtless been much enhanced by the contributions to its appendix of Messrs. Eastwick and Aganur. As it was passing through the press, I printed a small edition in Persian of the Zarthust-Námah, or Legendary Life of Zoroaster², which the former of these gentlemen had kindly rendered into English at my request.* Synchronously with it, too, the printing was going on, under my own eye, of the Vandidád, Yaçna, and Visparad of the Avastá, in the Zend language but Gujarátí character, and with a Gujarátí Translation, Commentary, and Paraphrase, by the late Frámjí Aspandiárjí and other Dasturs. The manuscript of this work, in five considerable volumes, I had purchased at Daman from the late Far-dunjí Meherazbánjí, in 1835, for about Rupees 500 ; but the expense of lithographing a small impression of it, amounting to some two or three thousand rupees, was, on the suggestion of Drs. Buist and Malcolmson, entirely defrayed by the Society. Though by no means of an authoritative character,—for it is founded more on traditional than philological principles,—it has been esteemed a boon by the learned societies and individuals to whom it has been presented, as an important contribution of its kind to the illustration of the Zendic literature, to which so much attention has of late years been directed in Europe by Burnouf, Bopp, Lassen, Westergaard, Spiegel, Roth, Brockhaus, and others. In 1842 Bombay had the privilege of enjoying a visit, undertaken purely in connection with the Zoroástrians of Western India, of Professor Westergaard of Copenhagen, one of the most distinguished scholars which Europe possesses. We had the privilege, during the months that he was at the presidency, of holding much intercourse with him, and of enrolling him in the list of our honorary members. From India he proceeded in 1843 to Persia, where he visited the remnant of the Gabars at Yazd and Kirman, and made additions to the great stock of Zoroastrian manuscripts procured in the East by his honoured predecessor, Erasmus Rask. On his return to Europe, he commenced the preparation of a complete critical edition of the whole of the Zend texts with notes in English ; of a Grammar and Dictionary of the two dialects embraced by the Zend writings ; and of a translation and exposition, also in our

* To Professor Eastwick our Society is also indebted for the translation of the Kissah-i-Sanján, or History of the Arrival and Settlement of the Pársis in India, published in the Fourth Number of our Journal,

language, of the whole of the Zend-Avastá, as thus edited and illustrated by himself. While preparing the Avastá in its original, he has carefully examined and compared the manuscripts taken from the East by Rask and himself, now in the university library at Copenhagen ; those which formed the earlier acquisitions of Anquetil du Perron, including the additions to them by M. Burnouf, now at Paris ; those in the libraries of the East India Company, British Museum, and the University of Oxford, in England ; those which I have myself acquired during the last quarter of a century in India ; and a few transcripts and collations with which I have been readily favoured for his use by the successors of Mulláh Firuz and Mr. Dhanjibhái Frámjí. The results, as far as the learned professor has advanced in his great undertaking, are most satisfactory and encouraging. His edition of the Zend-Avastá, as far as it is now recoverable, and the first which has appeared in print in a complete form, is now on our table ; and every person who examines it must admit the extreme care and attention with which it has been executed. The last fasciculus of it contains the Preface and Introduction to the whole. At the general results which it indicates we may glance for a few minutes. The oldest Zend manuscripts in existence are now in Europe. They were written in 1323 from copies from Persia, and have consequently not an Indian source. The later manuscripts have been prepared both in India and Persia. They all contain the same text, disfigured often, however, by cacographies, interpolations, repetitions, and omissions, to the removal of which a rational criticism has to be applied. Though they occur mainly in a fragmentary form, they are the remnants of a collection made many years posterior to the composition of its pieces. They are not the production of a single man, be it Zoroaster himself or one of his disciples ; nor "have they ever formed an exact, scientific, and self-consistent system of religious belief and lore." The several portions of the Avastá, like the hymns of the Vedas and the songs of the Edda, have sprung from different bards and teachers, who have represented their particular subject each according to his own view. Tradition assigns Zoroaster, to whom they are ascribed by the Pársis, to Bactria. The opening of the Vandidad, their historical and doctrinal portion, shows a very limited acquaintance with any countries not adjoining to Bactria ; the Yaçna, their largest hymn collection, leads us to infer that the distinct tribes of Ragha, mentioned in the Avastá, did not recognise any spiritual master common to the whole nation ; and none of the ancient texts take any notice of the names either of Media or Persia. We are led to associate these texts, in consequence, with a time anterior to Cyrus who conquered Bactria,

and perhaps to Dejoces who collected the tribes of Media into one nation under his own sway. Their language in its two proximate dialects of the mountains and plains of North Irán, for such there are, has a greater store of grammatical forms, and has an appearance less worn and smoothed down, and is consequently more ancient, than the old Persian tongue of the inscriptions of Darius, the nearest cognate branch. Some of the texts may have originated in a later age; but these must be comparatively few in number, and are probably anterior to their delivery to the nations of Western Irán for further cultivation. When this extension of the lore of Zoroaster to the west occurred is not known. Herodotus does not mention the name of Ormazd, the greatest god of the Avastá; but Darius, the son of Hyrcanus, we find, from his tablets, invokes him as the creator of heaven and earth. The faith ascribed by Herodotus to the Persians is not distinctively the lore of Zoroaster; nor were the Magi in the time of Darius the priests of Ormazd, nor favourites of that the greatest of the Persian kings, by whom, indeed, they were cruelly treated.* The legendary traditions of the Pársí refer not, as has been long thought, to the Achæmenian princes, but to the personages of a North-Iranian mythology, terminating with Vishtáspa and his son, with whom the Achæmenian Artaxerxes the Long-handed has been associated, as if he had specially contributed to the propagation of the Zoroastrian belief in Western Irán. The Magi, eventually turning to the faith of their sovereign, became the priests of Ormazd. The Zoroastrian doctrine of god in his qualities, however, never became the universal and popular belief. The inferior physical divinities, partly congenial with the ancient gods, assumed higher stations, and Artaxerxes the second and third erected temples to Mithra and Anáhita, or Venus. Of this later development we may have a few memorials in Zend, composed, notwithstanding, in the same idiom as those from Bactria. With this general view of matters I entirely agree; and that for the reasons alluded to by Mr. Westergaard. The state of society and priestly authority referred to the Vandidád is certainly not that of the Achæmenian sovereigns of Persia, who, if they were the men which their own tablets and the Greek histories represent them to be, never could have tolerated the administration of the peculiar law which that work contains. It could not have originated in the Parthian times, which were so much under the influence of the civilization introduced by Alexander and the Greeks. Pársí tradition refers

* Compare with this the opinions of Colonel Rawlinson in Jl. of R. A. S. vol. xv. pp. 245-256.

the revival of its influence to the Sassanians of Iranian descent, who rose against the Parthians, A. D. 226; and it is almost certain that it was in the reign of these princes that the collection of the Zend fragments, such as we now have it, was formed from the memoriter repetition of the Mobeds, or possibly from writings possessed by them from an earlier age. From the fall of the Achæmenians to the rise of the Sassanians, five centuries had intervened; and in this interval, not to go further back, much might be forgotten and mistaken. This, says Mr. Westergaard, accounts for the fragmentary state of the Zend writings, and the "unintelligible passages, mutilated sentences, and uncouth words, where recollection must have failed, or where only defective pieces of written documents were preserved," without impeaching the honesty of the Mobeds of those times, who appear to have done their best, connecting the fragments together and disposing of them in liturgical form, with a few connective sentences and pieces, and that often without regard to their congruousness or self-consistency. With these attempts to preserve the texts, the Mobeds, probably in the later periods of the Sassanian rule, which terminated before the middle of the seventh century, combined that of preserving their interpretation in a language called Pehlevi. "But the name Pehlevi," says Mr. Westergaard, "has, in so far as it concerns us here, two distinct significations. The official language of the Sassanian kings was called Pehlevi, and this is not any Iranian tongue, but, as far as I have been able to decipher it, a Semitic one, in two closely related dialects, with some inter-mixture of Persian words. As this idiom was the only one which the Sassanians employed on their coins, and in inscriptions placed not only at the western borders of their empire but also in the very centre, at the ancient Persepolis, I scarcely doubt its being the only Pehlevi language of that age, the only one used in writing, and consequently opine everything composed in those days to have been indited in what I would call the Sassanian Pehlevi. But this Semitic language differs essentially from what Nerissa [the Sanskrit translator of a part of the Avastî] calls Pahlevi (Vāhlavi-bhāshā), which has, indeed, the same written character, but is by nature Iranian and particularly Persian. This is the proper Zand or *commentary* language; it is employed in the composition of several works long after the fall of the Sassanians, and has remained in use to this day. The way of writing the Zand-Pehlevi is called intricate by Neriosangh; and so in fact it is, not only from the external shape of the several letters and combinations of letters, but especially from the great number of arbitrary signs or ideographs for pronouns, prepositions, and particles, which have the appearance

of real words ; and from the adoption of Semitic words strangely marked by peculiar signs, which pertain to the writing and do not enter into the language. Therefore, whenever the Zand-Pehlevi is transcribed into other characters, the Zend, Persian, or Gujaráti, and thus the *Zand* is explained or made readable by a *Pázand*, all signs of every description are expressed by the words which they represent ; the Pazand language being the same as the Zand-Pehlevi, differing only in the written letters about in the same way as the Hindustání and the Hindí. The identity of the Zand-Pehlevi and the Pázand language, hidden to the Pársi teacher of Anquetil, was known by Neriosangh, and the Persian lexicographers have justly referred the Zand-Pehlevi words to the idiom of the Zand and Pázand. The object in disguising the Persian dialect made use of in such a singular, artificial, and unnatural garb, by which the very language assumes a foreign and uncouth appearance, could not possibly have been to make the books thus written accessible to the layman, for the writing, being too difficult, requires no inconsiderable study. It seems to me to have been quite the contrary,—a wish to conceal them from the people, as well as to surround the learned and initiated with an additional show of erudition in the eyes of their own brethren, and perhaps also of the believers in the victorious Islám. As the Zand-Pehlevi, derobed of the artificial gash of its written characters, agrees with what we know about the Deri, as it has adopted words from the Sassanian Pehlevi, and in general displays a dialect somewhat different from that which has grown into the common Neo-Persian, I am most inclined to refer the fabrication or invention of the artificial Pehlevi writing and the composition of the Zand-Pehlevi translations and commentaries to a period shortly before or after the fall of the Sassanians. These translations may have been based upon older ones, indited in the Sassanian Pehlevi, whence also Semitic forms might have been taken, but they have not influenced the digest of the ancient texts ; on the contrary, in trying to render the text word for word, they betray how scanty the knowledge of the sacred language must have been at that time. Still these Pehlevi translations have a very great value, both because they give us specimens of a Persian dialect older than the modern Persian language, and because they display the state of the ancient texts at a period anterior to that of the oldest MSS. Yet their importance is much lessened by their having reached us only in single manuscripts, and by the suspicion that the transcribers have not thought it necessary to reproduce the translation with the same fidelity as was required for the text.” These are interesting statements as to matters of fact well worthy of

being noted. Mr. Westergaard thus, in substance, continues the history of the Zoroastrian writings. The defeats at Cadesia and Nehavand (A. D. 636 and 641) overthrew the Sassanians and struck a mortal blow at Zoroastrianism, which was soon restricted to Yazd and Kirman, nearly isolated by partial deserts. The Zoroastrian manuscripts originating from these contiguous districts form, with all their minor variations, but what may be called a single recension. The first arrival of the Pársis, a small colony from the Iranian stock of the Zoroastrians, in India, is involved in obscurity, though tradition associates it with the fall of the Sassanians and the island of Ormus as its starting point. Commerce, too, may have had its influence in its origination and promotion. Though excluded from the Hindu community by the system of caste, the Pársis early lost any books of the Zoroastrian faith which they might have brought with themselves to this country. In the fourteenth century, as they themselves allow, their copies of the Vandidád had altogether perished. The priest Mahyar brought from Yazd the copies of the Vandidád with the Pehleví translation, from which all the extant manuscripts of that work are descended. The original of all the Indian Vandidád Sadáh manuscripts, that is, the Vandidád arranged liturgically, must have also come from Yazd, perhaps not long before the beginning of the seventeenth century. In the beginning of the eighteenth century, Jámásپ affirms that there was not in India any copy of the Farwardin Yast. All the Indian manuscripts, as we have already said, have had a Persian origin.*

So much for the results of Mr. Westergaard's labours, as intimated in the first volume of his work, which has lately appeared. Further notices we have of them in his valuable paper on the Ancient Iranian Mythology in the Eighteenth Number of our Journal. We shall shortly, we hope, have it in our power to compare them in detail with those of the learned and zealous Professor Spiegel of Erlangen, who is also editing an edition of the Zend writings, with a German translation, of which

* Our venerable and zealous member, Mr. Romer, still holds the opinion that the Zend is an artificial fabrication. See his pamphlet entitled, "Zend : is it an original Language ?" published in London in 1855. Though his scruples—founded principally on the obscurity of the history of the Zend, the difficulty of its infitting with the Persian, the comparative worthlessness of its literature, the tampering of the Pársis with the Pehleví, the fabrication of the language of the Dasátir, etc.—have in some quarters not been treated with sufficient respect, they will probably vanish under the present extended study of the Zend, the genuineness of which, as a whole, is most apparent to those who most attentively mark its peculiar and numerous relations to the other Indo-Teutonic tongues.

several parts have already appeared, and who has also published grammars of the Pársí and Pehleví languages, which are anxiously looked for in India, more particularly after the notices which he has given of them through our learned associate Mr. Murray Mitchell, to whom, I would observe in passing, our Journal is indebted for valuable and judicious abstracts of several of the very interesting papers in Zend literature published in the fresh and able Journal of the German Oriental Society, certainly one of the most vigorous of all our oriental periodicals. With a Westergaard and Spiegel engaged in Europe in the deepest researches connected with the Zendic and Pehleví literature we may well in this place make a general pause in our labours as far as its essentials are concerned. We may, however, I conceive, continue, with much advantage, to act as their humble auxiliaries. Should any Zend fragments have been overlooked by Westergaard, let them be speedily brought to his notice, both on his own account and that of Dr. Spiegel.* The Pársí method of treating the Pehleví languages will be interesting to the philologers of Europe, when fully explained to them; and much light, I conceive, can be cast on it by the collection and republication of the quotations which have been made from it, with their accompanying readings and interpretations, often of an opposite character, by Edal Dáru and Mulláh Firuz in the Kíbzízah controversy. Mr. Dhanjibáú Frámí's Pehleví Grammar in Gujarátí, though very brief, is an acceptable offering to oriental literature; and much more so will be the Zend Dictionary which he is about to publish, though, as he is aware, it will be merely a help to our friends in Europe, who are entering so deeply into all questions connected with the Zoroastrian lore. Every Pehleví work possessed by the Pársís, whether a translation of the Zend, or an original composition, should be given to the public. I am happy to be assured by the distinguished family of Sir Jamsetjee Jejeebhoy that copies of the Wajarkard in this tongue, printed for the Jamsetjee Translation Fund, will now be presented to all competent parties by the managers of that Fund.†

From the Zoroastrians I pass on to the Jainas, the principal habitats of whom is now in Western India, where three of their five sacred mountains, A'bu, Pálitháná, and Girnár, are situated. They are among

* In consequence of the remark here made, two Zend pieces, not yet printed, have just been put into the hands of Dr. Wilson by Dastur Peshutan and Mr. Pestonjí Mánékjí (at the request of Sir Jamsetjee Jejeebhoy) and forwarded to Professor Westergaard.

† An adverse critique on the Wajarkard, principally from a religious point of view, has just appeared in Gujarátí at the Oriental Press.

the most enterprising of our native merchants ; and their influence, for good or for evil, is daily extending in the provinces of Gujerat and Rajputana, in which they have systems of proselytism, unknown almost to other classes of the natives, very actively at work. They are a sect of Buddhists ; but the history of their secession from the parent stock is yet unknown. The most valuable of the local chronicles, intermixed with incredible legends, are in their possession. Their own literature, though full of extravagances, is of a curious character, and is far too little studied. A valuable contribution to its elucidation is the volume by our learned associate, Dr. Stevenson, which contains the translations from the Maghadî, through the help of the Gujarâti, of their Kalpa Sûtra, to which they attribute great importance, and of the Nawa Tatwa, expository of their metaphysical tenets. To Dr. Stevenson we are also indebted for some remarks on the relation which exists between the Jaina and Brahmanical systems of geography. Colonel LeGrand Jacob has given us transcripts, with translations, of the principal inscriptions on their temples at Pálithâna ; * while Professor Wilson has given us the material and meaning of those, of a more important character, found at A'bu.† Dr. Glasgow, of Râjkot, has published a translation of one of the hymns used in their practical worship, which forms a very curious document. It was generally understood that our library contains some valuable portions of their literature in manuscript, but a late examination of the volumes in our possession which were thought to embody it has convinced me that their worth has been over-estimated. The following are the pieces of which they are composed. The Upâsam Sûtra, in Maghadî and Gujarâti, treating of Morals and Manners. The Râyapases Sûtra, in Maghadî, on the Jaina Doctrine and Practice of the Preservation of Animal Life. The Jivabhigam Sûtra, on Things Physical and Moral. The Uttaradhyana Sûtra, read for the Jainas when they are dying. The Prithivi Râj Vâla, a genealogical work. The Surya Pragnaptî (or Pannatî) Sûtra, the Natural History of the Sun. The Hîra Surya Suri Prâsadikrit Prasho Haar Samudayet Shishya Pandit Kirti Vijaya, explanatory of the principles of the Jaina religion. The Dasavî Kâlik Sûtra, on Chastity. The Harsh Kola Dipika Sûtra. The Thâunang Sûtra, on Physiology. A Jaina Catechism. The Anuttara Vavâyi Sûtra, a History of the Inferior Deities of the Heavens. The Hômachandra Samvîdh Nâm Kosha, the well-known

* Lord Elphinstone, on his late visit to this locality, had these inscriptions re-copied. The newly furnished text remarkably agrees with the old.

† See Translations of the Asiatic Society of Bengal.

Dictionary of Héinachandra. Most of these works are, in all probability, more curious than useful. I am acquainted with a native competent to translate any of them from the Maghadi into Maráthí, from which portions of them, after comparison of them with the original, might be transferred into English, for publication in our Journal. More valuable acquisitions than they are would be the Charitras of some of the different Rajput princes, such as the Kumár Pál Charitra, and the Mahátmyas of the sacred mountains, such as the Shatranji Mahátmya of Pálitháná, which are in the hands of the Jainas.

Of the Buddhists, whose religious development is of exceeding interest in the history of India and the adjoining countries, and whose works furnish the only key which has yet been found to ancient Indian chronology, we have no living representatives in our neighbourhood. Their most important ancient remains, however, are at our very doors, many of them, which had escaped notice for ages, having been lately brought to light. The following is a list of the papers treating of them which appear in our late proceedings, according to the dates which they bear. On the Ashoka Inscriptions at Girnár, by Captains G. L. Jacob and N. L. Westergaard, Esq. Brief account of the Minor Baudhā Caves of Bedsa and Baja near Kárlá, by N. L. Westergaard. Mr. Prinsep's Correspondence with Dr. Burn on Indian Antiquities. Historical Researches on the Origin and Principles of the Baudhā and Jaina Religions, by James Bird, Esq. Correction of Errors in the Lithograph of the Girnár Inscriptions by Capt. LeGrand Jacob. Memoir on the Cave-Temples and Monasteries and other Ancient Buddhist, Brahmanical, and Jaina remains of Western India, by John Wilson, D.D. Memorandum on some Buddhist Excavations near Karál, by H. B. E. Frere, Esq. Note on the Rock Inscriptions in the Island of Salsette, by J. Stevenson, D.D. Second Memoir on the Cave-Temples and Monasteries, and other Ancient Remains of Western India, by John Wilson, D.D. Historical Names and Facts contained in the Káñhéri Inscriptions, by J. Stevenson, D.D. On the Násik Cave-Inscriptions, by J. Stevenson, D.D. Buddhist Cave-Temples in the Tirkárs of Baitalwádí and Daulatábád, by W. H. Bradley, Esq. Sahyádri Inscriptions, by J. Stevenson, D.D. Description of the Caves of Kalví in Malwá, by E. Impéy, Esq. Descriptive Notices of Antiquities in Sindh, by H. B. E. Frere, Esq. All these papers are in addition to the well-known papers of Mr. Erskine, Colonel Sykes, and Captain Dængerfield, and contain important information, with statements of opinion and speculation worthy of respectful attention. Other valuable papers on the matters to which I now refer, especially by Dr. Stevenson and the Messrs.

West, have been laid before the Society. Government has shown great liberality in procuring, through Mr. Fallon, many pictorial illustrations of the Buddhist and also of the Brahmanical Cave-Temples and other excavations, though much remains to be done—by photography, as has been lately resolved on—for the full representation of these historical wonders. We are also indebted to it for the employment of an officer in connection with our Cave-Commission for copying the Buddhist inscriptions at some of the principal excavations. Notwithstanding the diligence of Lieut. Brett in the work last alluded to, it has not—perhaps owing to the fault of the lithographer, for whom Mr. Brett is not responsible—been altogether successful. Major Cunningham, the distinguished Buddhist antiquarian, and I, on a visit the other day to Káñhéri in Salsette, on comparing the copies of the inscriptions in our Journal with the originals at that place, reluctantly came to the conclusion that the discrepancies, principally in letters which the wear and injury of the rock has rendered difficult of decipherment, are so numerous that confidence in the translations which have been so commendably attempted of them by Dr. Stevenson and others must be greatly impaired, and that it is inexpedient to invite the particular attention of orientalists to them till they have all been minutely collated with the originals. Were Mr. Brett at hand to make the collation, he might be again employed for the purpose; but in his absence no better way of dealing with them occurs to me than that of our employing a learned native who knows the Cave character and language,—and such a qualification is required for successfully dealing with them,—for their exact revision in connection with a new attempt to translate them. A correct edition of the Girnár tablets, we may presume, may now be obtainable from a collation of the various copies which have been made of them. Mr. Prinsep's attempts to translate these tables have been greatly improved by Professors Wilson and Burnouf. I rejoice to be able to intimate that what remains to be done respecting them will probably be attempted by a most competent party, Mr. Edward Thomas, of the Bengal Civil Service, who is now in correspondence with myself respecting them. Our Cave and Antiquarian Commission still exists; and its inquiries continue to be prosecuted without intermission. We regard with special interest the *Lilata Vistara*, the legendary life, of Buddha, now publishing in the *Bibliotheca Indica* at Caleutta. Sir Erskine Perry has furnished our Journal with an abstract of his life, after Lassen, whose great work on Indian Antiquities is invaluable.*

* Translations of portions of Lassen's *Indische Alterthumskunde* have appeared

More interesting, in certain respects, than departed sectaries, are the existing masses of the living population of India. The Indian ethnographical papers of our members are of particular value. Among these are to be noted those of General Briggs, on the Banjharás, in our Transactions; of Sir John Malcolm, on the Bhills, in the Transactions of the Royal Asiatic Society; of General Walker and Captain MacMurdo, on various tribes in Kachh and Káthiáwád, lithographed by Government, or published in our Transactions; of Mr. R. C. Money, on the Kapriás, in the Transactions of the Royal Asiatic Society; of Dr. Wilson, on the Wárális and Kátodís and other Mountain and Forest Tribes, in the Journal of the Royal Asiatic Society, and in his work on the Evangelization of India; and on the Jádejás and other Rajputs addicted to Infanticide, in his History of the Suppression of that horrid custom, just published; of Captain Postans, on the Kánphatís of Dámodar, in the Journal of the Bengal Asiatic Society; and of Colonel LeGrand Jacob, on the Tribes in Káthiáwád in general, in the Journal of the Bombay Geographical Society. Some most valuable documents of this description, which have been for a considerable time in the Government archives, are now being published in the Selections from the Government Records which are appearing under the auspices of our present distinguished patron. It is a matter of comparatively little consequence how they be laid before the public; but their value would probably in some instances be enhanced if they appeared first in the general proceedings of a Society looked to for information on all the diversified tribes and tongues of this great country. I repeat the opinion, that the acquisition of knowledge respecting them is of very great consequence. "Whatever tends," says Robert Hall, "to render our acquaintance with any portion of our species more accurate and profound, is an accession to the most valuable part of our knowledge." Before we can govern our subjects in India aright we must know them. The inexpediency of the neglect of even the most insignificant tribes, in our general schemes of enlightenment and industrial improvement, is sufficiently illustrated by the present relations to our ruler of the savage Santhals in Bengal. Some curious facts relative to some of the aboriginal tribes around us have lately been noticed. The Parwáris of the Maráthí country, now so degraded, are the Porvási of Ptolemy of the second century, in his days evidently a considerable people. The

in late volumes of the Oriental Christian Spectator published in Bombay. It is greatly to be regretted that the whole of the work is not rendered into English under the auspices of its eminent author.

Bhills are the Phyllitæ, and Gonds the Condali of the same author. The latter people I take to be the representatives of the Chandâls, or erroneously esteemed "outcasts" of the ancient Hindus. The Shûdras were originally a people on the banks of the Indus. The Kunbî cultivators of the Dakhan should not be reckoned so much Shûdras as Vaishyas; and from their appearance and language they are probably mainly a branch of the high A'ryâ family. In fact, they are called A'ryars to this day by their neighbours the Canarese. The Ahîrs of Kachh and Káthiawâd are the descendants of the Abhîrs of the Purânas. Their original country in Sindh is called Abiria by Ptolemy. The Mângs belong to the Southern family of Indians. They still retain many Canarese words in their vocabulary.

In regard to Hindu literature, our Society had, and still has, its own special duties to perform. In this department, the services of Major Edward Moor and General Vans Kennedy among our deceased members are universally admitted, while those of Dr. John Taylor are not to be overlooked. My own expositions or exposures of Hinduism, which come next in chronological sequence, though they have had their own influence on native enlightenment, having been composed by me at an early stage of my oriental studies, are not what I would wish them to be, and am endeavouring by degrees to make them. Dr. Stevenson did not put his name to the specimen of the Rig-Vâda, with English and Marâthî translations, which was lithographed at Pûnâ in 1832; but it is worthy of notice as, after the extracts of Colebrooke, the first consecutive portion of the till lately mysterious Vâdas given to the European public. In conjunction with Major Shortrede, he procured for Professor Burnouf of Paris some of his Vâdic manuscripts, at a time when the scruples of the Brâhmans led them to withhold them from the gaze of the impure Mâchchhâs. His own edition of the Sâma Vâda, though superseded by the more critical one of Benfey, with its various readings and valuable indices and glossary and translation, was at the time of its issue, as well as its translation, a desideratum. It is perhaps well that in the matter of Vâdic editorship no duties are now required of any of our number. With imperial liberality the East India Company is presenting to the literary world the whole of the Rig-Vâda with the commentary of Sâyana Achârya, under the able editorship of Dr. Max Müller. This work, as it proceeds, is being translated by the most trustworthy hand which Europe affords, that of Professor H. H. Wilson, two volumes of whose version have already appeared. Dr. Albrecht Weber of Berlin, in every respect a most competent party, and the editor of the interesting *Indische Studien*

now appearing in that city, is giving us the whole Yajur-Véda ; while Dr. Roth, well known for his Védic and Zendic research, and Mr. Whitney, a young American gentleman, are unitedly publishing the Sanhitá of the Atharva Véda, not the least curious of the Védic collection. All these works are in addition to the translation in French of M. Langlois of the whole of the Rig-Véda, the first complete version of that work which has been executed, and which will not be overlooked in the history of oriental literature. The Bráhmaṇas of the Védas are awakening attention, and various extracts from them have already been printed by the orientalists of Berlin. The grammatical and glossarial works illustrative of the Véda will not be delayed. Dr. Roth has been busy for some time with the Nirukta. (It has perhaps been already published.) The most important works connected with the more advanced literature of the Hindus are almost all published, or preparing for the press. The Bibliotheca Indica is furnishing us with the Upanishads, edited and partly translated by Dr. Röer ; with the most important treatises illustrative of the Schools of Indian Philosophy, by Dr. Ballantyne and others ; with the treatises which contain the Hindu Astronomy, by Mr. Hall ; with the collection of the Puráṇas, begun to be edited by the Rev. Krishna Mohan Bánárjí ; and with other interesting works. What we require most for the West of India is the completion of the translation of the Bhágavata Puráṇa, of which three volumes were published by Burnouf before his death ; the publication of the text, with a translation, of the Sahyádrí Khand of the Skand Puráṇa, which contains our local legends, some of which so excited the wrath of the late Péshwah that he ordered every copy of the work which his emissaries could procure to be destroyed ; the translation of the Mahátmyas of the different months of the year, which throw more light on the present religious observances of the people than all other works put together ; the translation of the Mahátmyas of our principal shrines, and places of pilgrimage, as those of Dwáráká, Elurá, Násik, Jejurí, etc., which, though filled with absurdities, explain the popularity of these shrines, and many of the rites which are observed in connection with them, which are attracting increased notice, as exemplified in that of Jejurí lately visited by Mr. Murray Mitchell, as formerly by Dr. Stevenson and myself. Our vernacular literature does not afford very much of interest to the orientalist ; for the Maráthí poetry consists principally of paraphrases of the mythological legends of the Sanskrit works set forth in wretched versification, though it affords a few interesting gleanings, principally in the works of Tukobá, noticed by Dr. Stevenson and Mr. Mitchell. The proverbs of the Maráthí nation are

numerous and valuable. About five hundred of these were lately published in Puná ; but Mr. Murphy and myself have, independently of one another, formed collections containing respectively upwards of 1,800 of these proverbs, and giving altogether 2,200 when they are collected together. When the agreement in the amount of each of our collections was first noticed by Mr. Murphy, it occurred to him that some of the native assistants employed by us might have dishonestly possessed themselves of some of the distinctive fruits of our individual labour, disposing of them to the other party ; but the comparison of our manuscripts showed him that this was not the case. In a note to me, he says, " Your remark about the minute discrepancies in the text of the proverbs common to both our collections is very just. I see it very clearly ; and I agree with you that it is conclusive as to the independence of the sources whence they were derived. I think the proposal to combine the two collections, after a comparison of the texts, a very good one." This labour, I shall be happy if Mr. Murphy will undertake, either in connection with this Society or the Dakhan Vernacular Society. The Proverbs of Gujarát will probably not be less interesting than those of the Maháráshtra, though many of them may be found to have a common origin. The songs of Gujarát, of which a collection has been made by the Rev. Dr. James Glasgow, are very curious. The Rev. P. Anderson, one of our learned vice-presidents, has in an excellent paper given us an interesting account of the curious Bhatti Kávya, illustrative of the grammatical rules of the Sanskrit grammars of Panini and the Kaumudí. Dr. Stevenson has favoured us with several papers on the connection of the Northern and Southern Families of Indian Languages, a most important subject of research ; while Sir Erskine Perry has, in our Journal, attempted, not without commendable success, to sketch the boundaries of the various Indian Dialects. A Parallel and Comparative Grammar of the Maráthí and Gujáratí Languages, distinguishing their Sanskrit and Scythian elements, and illustrating them by references to the cognate tongues, appears to me—notwithstanding the meritorious grammatical works of Dr. Stevenson and Messrs. Clarkson and Burgess—to be a great desideratum in our local philology. The lexicographical labours in the Maráthí of Mr. Molesworth, formerly aided by the Messrs. Candy, are unsurpassed by any connected with oriental literature. A new and greatly improved edition of the Maráthí Dictionary is at present in the press. Most important services to our Indian and Persian literature are being rendered by our learned member Professor Eastwick, and his associates, who, in connection with the press of Mr. Austin at Hereford,

are reflecting much honour on our country in the eyes of foreign orientalists.

I pass on to the Musalman literature. The most intelligent and judicious digest of the Muhammadan History of India which has yet been given to the public is that of our former distinguished patron and president the Hon. Mr. Elphinstone. Mr. Erskine's History of India under the two first Sovereigns of the House of Taimur, Bâber and Hamâyûn, is an entirely exhaustive work, founded on oriental authorities, most difficult of acquisition and interpretation, and which leaves nothing further to be desired respecting the affairs of which it treats. The principal Muhammadan Histories of India noticed by Sir Henry Elliott are about to be published by the Government of the NW. Provinces, with the exception of those which have already been printed in Bombay. Dr. Sprenger, the best Arabic scholar in this country, is preparing a great work (a part of which, to be afterwards enlarged, was printed at Allahabad in 1851), the Life of Muhammad from original sources, to which a large accession has been procured by him during his late visit to Syria and Mesopotamia.* He is also, with his zealous coadjutor Lieutenant Lees, and others, laying most valuable works connected with Saracenic history and science before the public through the *Bibliotheca Indica*. Several learned and original papers connected with the biography of Muhammad have lately been published in the Calcutta Review. By the lapse of the Sâtârî state, the Bijâpur collection of Arabic and Persian works has become the property of the Bombay Government, which has been taking counsel as to the best method of its disposal. On the city of Bijâpur and its Inscriptions, our Journal contains a valuable paper by Dr. Bird, who has also furnished the Society with a History of the Kalhora family of Sindh by the late Captain MacMurdo, and other interesting papers. Capt. Burton has added much to our knowledge of the languages and people of the Valley of the Indus, which has been still further illustrated by valuable papers published by the Bombay Geographical Society.

To the department of Antiquities to which the attention of our Society is frequently directed, I have already in some respects referred in connection with Buddhism. A few additional notices, however, are still required for the completion of this brief sketch. Highly interesting Scythian remains have been brought to notice as existing in the Dakhai by the able papers of Captain Meadows Taylor. Our Journal

* To his store of Arabic manuscripts, the best in any private collection, Dr. Sprenger has, since the reading of this address, procured some most valuable additions in Bombay.

has a few numismatological notices, illustrative of individual coins and collections of coins which have been laid before us. The capital of the Sinhas in Gujerat, so long amissing, has been identified by myself with Sihor in the Goelwad province of Káthiawad. (See Second Memoir on the Cave-Temples.) Walabbhi, Pattan, and other ancient sites have been examined without any considerable results. The Rev. Mr. Anderson has reviewed the genealogy of the Walabbhi princes.

Natural History and Natural Science have often been cultivated in India in union with oriental literature. Jones, Colebrooke, and Carey were nearly equally distinguished in both departments. A division of labour in respect to them, however, is at once to be expected as a general occurrence. In the field of Natural History, Mr. Carter, our able and zealous secretary, and Dr. Buist, have been our most indefatigable and successful collaborateurs. Dr. Carter's geological, zoological, and botanical papers deservedly occupy the largest space in our Journal; while the most important of those of Dr. Buist appear in that of our Geographical Society, of which he is the energetic executive. The Rev. Messrs. Hislop and Hunter of Nagpur have contributed much to the illustration of the Geology of Central India. In Dr. Gibson, Mr. Law, Mr. Niemmo, Mr. Dalzell, and other friends, we have some of the best of Indian botanists.* Colonel Sykes honours Britain, as well as Bombay, in the principal physical societies of Europe.

With the mention of Dr. Carter we cross the Indian Ocean. His contributions to the Geology, Geography, and Ethnography of the Coast of Arabia are the most instructive scientific documents which we yet have, connected with that interesting portion of the world. In our Journal, we have several valuable papers on Aden, Abyssinia, Egypt, and the Red Sea by Dr. Bird, Mr. Orlebar, and others. Without presuming to take the members of the Society at present in my own company to the "Lands of the Bible" or the ruins of Al-Hadhra, which I have identified with the Hazor of Jeremiah, I may make their pause with silent admiration for a short time at the tablets of Behistun, and the wonderful remains and records of Nineveh and Babylon with Colonel Rawlinson, who so lately delighted us and instructed us in this place, and who is now, with so much promise, prosecuting his literary researches in Europe. On the Topography of Nineveh, an invaluable paper, accompanied by maps, has just appeared in the Journal of the Royal Asiatic Society, the fruit of the observation and research of Commander Jones, of our Indian Navy. Captain Burton, though in a disguise

* A new and enlarged edition of Graham's Catalogue of Plants in the Bombay Presidency and its vicinity is a great desideratum.

which is not to be commended, has, after Burckhardt, thrown a flood of light on the Holy Land of the Muhammadans, and on the views, feelings, observances, and hardships with which they perform its barren pilgrimage.

Before concluding, on this occasion, I would respectfully make a few distinctive proposals for the consideration of the Society, with a view to the increase of its efficiency and the extension of its research. I am particularly encouraged to do this by the attendance on the present occasion of our Right Honorable Patron, whose zeal for the well-being and well-doing of the Society is quite in accordance with the distinguished and exemplary interest which he takes in every object connected with the improvement and advancement of Western India.

The following, I think, are among our most important desiderata :—

1. The regular publication of the Journal, at intervals not exceeding six months in ordinary circumstances, it being understood that the Secretary, with a view to the abridgement of his labours in editing it, shall enjoy the assistance, when practicable, of the members furnishing articles to its pages.

2. The presentation to the Society by Government of all official articles of a literary and scientific character bearing upon the objects which it is intended to advance, for illustration and comment and precise scientific editorship in the Journal. For example, the copies of old inscriptions which appear in the valuable volume on Kolápur published by Government might have been handed over to the Society, and given forth in a suitable form, with an identification of the dynasties, etc. to which they belong. The ethnographical papers, too, might well go through the ordeal of the Society. This disposal of them, in the first instance, would not be inconsistent with their subsequent introduction into the Government Selections which are carefully edited by Mr. Thomas and others for official and general use.

3. The Society should systematically seek to enlarge its library of printed books and manuscripts in the oriental and scientific departments, so as to afford every facility to its members to engage in those peculiar studies which it professes to countenance and advance. In the case of needful oriental manuscripts our library is particularly defective. Though not one of the richest members of the Society, the exigencies of my own engagements have forced me to purchase, from first to last during the last few years, a vast many more than the Society has done in its collective capacity. For an indiscriminate purchase of manuscripts, however, I would not plead. I ask only the acquisition of those which are needful for our actual research.

4. The Cave Commission should be empowered by Government to employ a learned Native, acquainted with the Cave character, to collate the transcripts of the Inscriptions made by Mr. Brett, and published in the Journal, with the originals, with the view of correcting errors, which, for reasons already mentioned, are abundant, notwithstanding the care of Mr. Brett.

5. This learned Native should afterwards be retained in the service of the Society, like the Pandit of the Asiatic Society in Bengal, for aiding it in decipherment, translation, and other similar occupations. Colonel LeGrand Jacob, who feels a particular interest in the objects of this meeting, attaches much importance to such an arrangement as this. Why should we not immediately take steps to the publication, in connection with Government, of a *Corpus Inscriptionum*, embracing the whole of the ancient *documenta* on stone and copper to which we have access?

6. It is desirable that one of the clerks employed by the Society should have a knowledge of Natural History, to give effectual assistance to the Secretary in the care of the Museum.

7. A monthly grant of money in aid of the objects of the Society should be solicited through Government from the Court of Directors of the East India Company. Large sums are given to the Bengal Society, while nothing is given to that of Bombay but presents of books and the rooms in which we hold our meetings and accommodate our library and museum. It is to be observed that our voluntary pecuniary contributions to science and oriental literature do not fall short of those made on the banks of the Ganges. They amount in round numbers to about a thousand pounds per annum.*

8. The Library of the Society should continue to be available on easy terms to all parties seeking to advance the objects of the Society, whether they be members of the Society or not.

These simple suggestions I wish to be leisurely considered by the Committee in all their relations before they are discussed by the Society. At the same time, I submit them in the strong desire and hope that they may be adopted. The Society, I believe, is conscious that a great work, which it is well fitted to overtake, is still before it; and it is reasonably expected that it will not fail to discharge the duties to which it is called. The power of enlightening, governing, and improving India, in both its secular and sacred relations, is greatly dependent on our knowledge of its past history and present state: and we cannot

* The total sum raised by the Society during the last five years amounts to Rs. 47,050-11-5.

too thankfully acknowledge the services of those who contribute to make us acquainted with its external character, so grand and diversified ; with the peculiar springs and motives by which its varied tribes and tongues are influenced ; with the languages and dialects with which intercommunion with them is to be maintained ; with their actual condition as the subjects of the British empire, so providentially and wondrously established in these eastern parts ; and with their probable destiny in the renovation of the world through the Word and Spirit of the living God.

At the close of Dr. Wilson's address, the Right Honorable Lord ELPHINSTONE, who, as Patron of the Society, presided on the occasion, rose and said :—I have not only been much gratified by the admirable discourse of our able and learned Honorary President, but not a little surprised, though certainly most agreeably so, at the accounts given by him of the energy of the exertions, and celebrity and amount of the performances, of the Society. Though very familiar with the great fame it had acquired, and enterprises it had accomplished during the earlier portions of its career, I had somehow or other become impressed with the idea that it had of late years slackened in its labours, or that these had become less celebrated and less numerous than they had formerly been. The discourse we have all just listened to with such delight has dispelled this delusion. I cordially concur with its author in the importance of the Society's labours ; and I think it may confidently rely on Government doing everything in its power to assist it. I quite agree in the importance of pecuniary grants ; and think that the State which makes them, under such circumstances as the present, secures an ample return for its money. Nothing can be more true than what has been said in reference to the advantagous nature of our position for the prosecution of those investigations in which the Society is engaged ; and when we look around to the facilities we now enjoy for oriental study, beyond anything enjoyed by the founders of this Society, we must feel it doubly our duty to endeavour to turn these to account. Sir James Mackintosh, Mr. Erskine, and General Kennedy, the great labourers in the field in the earlier years of the Society, had neither collections nor manuscripts, library nor museum, to fall back upon. They had to trust exclusively to their own resources, and to provide aids to study and means of enlightenment for themselves.

His Lordship then recommended that the proposals of the Honorary President should be referred to a Select Committee composed of the office-bearers and of any members whom they or the Meeting might

wish to add to its number, and who should make a Report upon them to a future General Meeting. If adopted, he said, he should have great pleasure in supporting that portion of them which related to the communication of all subjects of interest to the Society which are to be found in the Government records, and in recommending the grant of some pecuniary aid.* The Court of Directors, his Lordship added, has always shown a laudable anxiety to promote the objects for which the Society was instituted, and he did not doubt that it would take the claims of the Society into consideration with its usual liberality. Lord Elphinstone also alluded to the advantages which the Society derived from the labours of other Societies in Europe, and from the interest in oriental research which has led so many distinguished men to devote themselves to it. He mentioned the mechanical advantages, as well as the literary ones which this generation enjoys over that which preceded it—he instanced lithography and photography especially, as affording great assistance in delineating antiquities, copying inscriptions, etc. And lastly, he alluded, among those who had done honour to the Society and to the country, to Colonel Rawlinson, whose interesting account of his discoveries in Assyria the Society had listened to a few months ago in that room. His Lordship concluded by moving a cordial vote of thanks to Dr. Wilson; this was carried by acclamation.

The business of the Meeting having closed, Colonel MELVILLE rose to propose the thanks of the Meeting to their Noble Patron, who had done them the honour of taking the Chair. The Members of the Society must not only have been highly gratified by what had fallen from him, but must have felt the fullest assurance that His Lordship would do his uttermost to promote the interests of the Society, and bring about the realization of the hopes of assistance from the Treasury which he had held out.

* Since the meeting at which these observations were made, Government has granted a monthly salary to a learned Pandit, who is to act under the Cave Commission in the primary collection and decipherment of the ancient inscriptions. The question of a general *Corpus Inscriptionum* for India has been referred to the Court of Directors.

ART. X.—*Development of the Root-cell and its Nucleus in Chara verticillata (Roxb.).* By H. J. CARTER, Esq., Assistant Surgeon, H. C. S., Bombay.

Read July 10th, 1856.

LAST year I found it necessary, on account of the investigations I was then making, to ascertain the physical features which the protoplasm of the first few cells of *Chara* presented on their development from the *nucule*; but, not requiring to go further, I merely commenced from the bursting of the vacuoles of the new protoplasm into each other, and followed this up to the full development of the rotatory motion.* Latterly I have found it necessary to extend these researches, that I might ascertain also the changes which the nucleus presents in the fresh-water Algae under cell-division, and having again chosen the roots of *Chara verticillata* for this purpose, I have been led to observe other features in the protoplasm which I had not before noticed, but which, together with the changes exhibited by the nucleus, I will now also describe.

Previously, however, it is advisable that I should state shortly, what has been published respecting the development of the roots of *Chara*, as well as that which is known of the formation of the nucleus generally, in the Vegetable Kingdom.

As regards the former, it has already been stated by C. Müller, in his excellent description of the development of *Chara*, that “as soon as the nucleary membrane [embryo-sac] began to burst through the sporular membrane [brown-coat], like a bladder, and to expand in a sacciform manner [to form the first cell of the plant-stem], it began to be developed in a sacciform manner on the opposite side” [to form the roots]. Nothing afterwards is mentioned about the roots, saving that, “each utricle forms a rootlet, and others follow it from simple

* Ann. and Mag. Nat. Hist. vol. xvii. pp. 110 and 111, pl. viii. fig. 35.—1856.

† Idem, vol. xvii. p. 254.—1856.

vesicular expansion of the nuclear membrane, so that it acquires at this end a complete head of root-fibrils."*

For what is known respecting the formation of the nucleus in the Vegetable Kingdom, I can quote nothing better than the result of Nägeli's researches, which he has summed up in the following manner, viz.:—"The nucleus originates in two ways; either free in the contents of the cell, or by division of a parent nucleus,† The first mode is witnessed in the embryo-sac of the Phanerogamia (*Scilla tenua*, &c.), wherein "globular drops of perfectly homogeneous mucilage with a defined outline" appear; after which the larger ones present an "enclosed ring"; and of these, he adds, "there can be no doubt, for the further development also confirms it, that the mucilage-globule is a cell-nucleus, the enclosed ring a nucleolus." He is also of "opinion that the nucleolus originates first and the nucleus subsequently around it";‡ lastly, he observes, "certain phenomena connect themselves readily with the hypothesis that they [the nucleoli] are utricles."§

As regards the second mode of origin, viz. that by division; this is witnessed in the nuclei which are formed on each side the "secondary nucleus" in the parent-cell of the spore of *Anthoceros*.||

Having thus briefly stated, as far as I am aware, the limits of our knowledge respecting the development of the roots of *Chara*, and the formation of the nucleus of the plant-cell, I will proceed to the subject of this paper, premising a short description of the first root-cell and its contents in the species of *Chara* mentioned, that the reader may recognise without doubt the parts to which I shall have occasion to allude.

This cell is a long narrow cylindrical tube, with one end attached to the *nucule*, and the other free. Its chief elements are the cell-wall and "primordial utricle" of Mohl.

Of the cell-wall nothing more need be said here than that it is as transparent, colourless, and apparently structureless, as unstained glass; but

* Ann. and Mag. Nat. Hist. vol. xvii. p. 250.—1856.

† Hawley's Translations, Ray Soc. Pub. "Reports and Papers on Botany," 1849, p. 162.

‡ Idem, pp. 106 and 107.

§ Idem, p. 172.

|| Idem, 1846, pp. 201 and 262.—*Himantidium pectinale* (Kg.) affords a good example of it among the Algae; and in the same way I have seen it in some of the cells projecting into the gum-cavities of the bark of *Hyperanthera moringa* (Roxb.), the *Horse-radish tree* of India; that is, both halves of the nucleus remaining opposite each other, on either side the septum, after the latter has divided the old from the new cell.

the protoplasm is composed of many organs, which I will first enumerate and then describe in detail. Thus, it is itself surrounded by a cell which we shall call the "protoplasmic sac"; then the protoplasm is divided into a fixed and rotatory portion; these again respectively enclose the nucleus, "granules," and axial fluid; while those small portions of matter which I have before designated as "irregularly shaped bodies"** are common to both.

Protoplasmic Sac.—This sac I have only been able to demonstrate satisfactorily by the aid of iodine and acids applied to the fixed protoplasm when it is about to undergo division for the second root-cell, as will hereafter be explained. Its existence, however, might be inferred, from iodine and acids failing to produce any separation between the fixed and rotatory portions of the protoplasm, for these cannot be considered to be in direct union, and, therefore, unless supported in their relative position by a membranous sac common to both, would most probably present a line of separation under contraction. Again, the "primary" nucleus ultimately becomes stationary in the midst of the rotating protoplasm, and it also must be fixed to something which is not only stationary itself but is also carried inwards with this part of the rotating protoplasm, when the latter is condensed and made to leave the cell-wall by acids; for the nucleus, or what remains of it, is at such times seen to be enclosed in the general mass of contracted cell-contents. Lastly, when the first root-cell assumes part of the function of the cell of the plant-stem, which is frequently the case, the green, peripheral cells appear in an abortive form, disposed in broken, scattered lines along its inner surface, and they also are drawn inwards with the general mass of rotating protoplasm under contraction from acids, with the remains of the nucleus within them again. Now these cells can hardly be supposed to be supported in their position by mere attachment to the cell-wall in the root-cell, any more than they are in the cell of the plant-stem, where they form a distinct layer. Hence, if the protoplasmic sac had not been seen, its existence might thus have been fairly inferred.

Protoplasm.—The protoplasm is a molecular mucus, which, as before stated, is divided into two portions, viz. a fixed and a rotatory portion. The fixed portion occupies the extremity of the cell, and extends backwards for about a hundredth part of an inch, while the rotatory portion occupies all the rest of the interior of the tube. The latter, which is more attenuated than the former, merely encloses

* Ann. and Mag. Nat. Hist. vol. xvii. p. 100.—1850.

the axial fluid, and presents a few of the "irregularly shaped bodies" scattered through its substance, with, perhaps, a globular cell or two in its cavity; but the fixed protoplasm not only also contains a few of these "bodies," but, in addition, the nucleus, and the group of corpuscles at the extremity of the cell, which I have called "granules."

Nucleus.—This organ is at first located in that end of the fixed protoplasm which joins the rotatory part, and then consists of three elements, viz. a transparent, globular cell, which Nägeli has called the "nuclear utricle"; a more or less transparent mucus, which partly occupies its interior; and the nucleolus or kernel, which is a spherical body composed of an opaque, yellowish, homogeneous substance, with a single hyaline vacuole in its centre. This is the primary form of the nucleus in *Chara*. Afterwards it enlarges, the transparent portion or cell becomes elliptical, the nucleolus becomes flattened, its single hyaline vacuole is replaced by several which vary in size as well as in number; and these again disappear and reappear, but whether from collapse of the vacuole or change in position of the substance of the nucleolus, I am ignorant. The nucleolus is also now continually but imperceptibly varying its shape, being at one time elongated, and at another sub-round. Finally, when the nucleus has ceased to subdivide for the purpose of furnishing the new cells with nuclei, it moves backwards a short distance, and then becomes permanently fixed to the protoplasmic sac, where it grows still larger, and, ultimately, its nucleolus divides up into a number of small nucleoli. When the second or following root-cell becomes terminal, that is, it ceases to throw out any more cells, the nucleus, after the breaking down of the fixed protoplasm, moves about for some time before it becomes fixed, and this is effected partly by the rotating protoplasm and partly by its own locomotive power, which at this time is, particularly evident, from change of form while under observation. I have stated that the "nuclear utricle" and its contents are transparent, but this is only in comparison with the turbid fixed protoplasm in which it is imbedded; for when it gets into the clearer cavity of the rotating protoplasm, it not only presents a cloudiness interiorly, but, a certain time after it has become stationary, also becomes filled with vacuoles, like those which will be found to be developed in the fixed protoplasm preparatory to its assuming a more attenuated form, and mingling with the rotatory part. In short, this is the last vital phenomenon presented by this organ; after which it passes into an effete amorphous piece of tissue, like cellulose.

Round or "irregularly shaped bodies."—These are small opaque

yellowish masses of protoplasmic (?) matter, irregularly scattered throughout both the fixed and rotating protoplasm, and seem to be the same as those which I have described under this head in giving an account of the contents of the protoplasm of the internode of the plant-stem, but they never grow large enough to arrive at those fantastic shapes which are found in the latter.* Like these, also, they are frequently seen appended to, or in the wall of a globular mucus-cell, and this cell may be transparent or clouded by the presence of molecular mucus, while it also frequently manifests a power of movement. Many of these bodies have very much the appearance of the small nucleoli into which the primary nucleolus divides, but as they appear in the cell before the latter takes place, this cannot be their origin.

Granules.—Lastly we come to the granules, which are of much interest, on account of their being grouped together in one part of the cell only, their marked characters, and their incessant oscillatory motion. They are situated in the fixed protoplasm close to the free extremity of the cell-wall, and are recognised by their dark margins, greenish colour, constant motion, and tendency to keep together in a group. At first they are round or elliptical, and of the tint mentioned, but after a while they become sub-round or angular, and colourless,—apparently, effete. When the fixed protoplasm begins to be broken up by the development of vacuoles, they are seen to be scattered among the latter; but after the rotatory movement is completely established, they cease to be recognised. Their office seems to be connected with the extension of the cell, as they are only found at its extremity and in constant motion, but whether this motion is produced by themselves or by the protoplasm in which they are imbedded, I am ignorant. They are also present in the young cell of the plant-stem, but disappear in the way which I have stated, and are then followed by the appearance of the rudiments of the green cells or chlorophyll-bearing cellulæ. Is their office of a like nature, or are they homologous with the latter?

Vacuoles.—These form no part of the permanent contents of the protoplasm, but are hyaline spaces, which are temporarily developed in the new or fixed protoplasm preparatory to its becoming attenuated and rotatory. As they increase in number and size so they burst into each other, until a large space is thus produced in the centre, round which the protoplasm gradually begins to rotate. As before

* Ann. and Mag. Nat. Hist. loc. cit. p. 106, &c. pl. viii. figs. 11-13.

stated, they appear in the nucleolus and in the mucous substance of the nuclear utricle when the nucleus becomes stationary; they also make their appearance in the rotating protoplasm, just preceding its death.

Having now described one of the first root-cells specially and typically, let us turn our attention to the whole bunch as they appear about twenty-four hours after the germination of the *nucule*. Here we shall find, as Müller has stated, that they are developed from the "nucleary membrane" (which, for convenience of description, we will now term "embryo-sac"), on one side the plant-stem,—at first as one hemispherical cell, which afterwards divides into four or more root-buds. The first cell of the plant-stem, on the other hand, projects from the extremity of the embryo-sac in the form of a parabola, whose summit becomes cut off, for the second cell or internode, by a transverse diaphragm; round the circumference of which, again, on the *lower* side, there is an annular projection, which lodges the protoplasm, that afterwards becomes cut off and divided up into cells for the first node or verticil; thus allowing direct endosmosis to take place, not only between the first and second cells of the plant-stem, but also between the first cell and the cells of the first node. Sometimes these cells pass into roots, as the cells of any future node may do if the occasion requires it. In the figure of the germinating nucule which I formerly gave, it would have been more complete had I drawn another diaphragm close to the sunmit of the nucule, and placed the roots in a bunch on one side of it, but the reader can do this for himself, and then he will have the first cell of the plant-stem and first bunch of roots now described.* When a second plant-stem is formed, which is not unfrequently the case, this is developed out of one of the root-buds; hence it is not uncommon to see one of the latter in an intermediate state.

Now if we take the simple root-cell about the eighteenth hour after germination, when it will be about half an inch long and $\frac{1}{10}$ of an inch broad, and place it in water between two slips of glass for microscopic observation, under a magnifying power of about 400 diameters, we shall find, the circulation be active, and the cell-wall strong and healthy, that the extremity of the latter, together with the nucleus and fixed protoplasm, which, as before stated, is about a hundredth part of an inch long and $\frac{1}{100}$ of one broad, will, in the course of about twenty-four hours, present the following changes:—

1st stage.—The nucleus, now about $\frac{1}{100}$ of an inch in diameter, is

* Ann. and Mag. Nat. Hist. loc. cit. p. 106, &c. pl. viii. fig. 35.

situated in that part of the fixed protoplasm which is next the rotating one ; it is also now globular, and its nucleolus, which is about the $\frac{1}{14}$ of an inch in diameter, spherical and opaque, with the exception of the single hyaline vacuole in the centre. After this, the nucleolus becomes somewhat flattened, its outline becomes sub-circular, and it presents several hyaline vacuoles of different sizes. The "granules" are now also in active motion at the other end of the fixed protoplasm, close to the extremity of the cell-wall, but, beyond these and the "irregularly shaped bodies," the fixed protoplasm presents nothing to interrupt its uniformity throughout its whole extent.

2nd stage.—After a certain time, during which the nucleolus has been successively changing its shape from a sub-round to an elongated form, and *vice versa*, it assumes a grumous appearance, becomes slightly enlarged, and, growing fainter in its outline, gradually but entirely disappears, leaving a white space corresponding to its capsule or cell-wall, with a faint remnant of some structure in the centre. Subsequently, this space becomes filled up with the fixed protoplasm, and after about an hour and a half—but this varies—the nucleus reappears a little behind its former situation, but now reduced in size, and with its nucleolus *double*, instead of single as before ; each nucleolus being about one-fourth part as large as the old nucleolus, and hardly perceptible. Meanwhile a faint septum is seen obliquely extending across the fixed protoplasm, a little beyond it, and, if iodine be applied at this time, the division is seen to be confined to the protoplasm, as the latter, from contraction, withdraws itself from each side of the line where the septum appeared, and leaves a free space, which is bounded laterally by an uninterrupted continuation of the protoplasmic sac. Hence the demonstration of the existence of this sac to which I have alluded. At this moment a spot, slightly lighter than the rest of the protoplasm, makes its appearance a little beyond the septal line towards the free extremity of the cell, and this is soon followed by the faint appearance of something else in its centre, which, as both become more defined, proves the former to be a new nucleus, and the latter its nucleolus. We shall, therefore, henceforth designate the first by the name of "primary," and the second by that of "secondary" nucleus. As the secondary nucleus becomes more evident, its nucleolus also is found to be *double*, and composed of two spherical nucleoli about the same size as those of the primary nucleus, when the latter first returned into view. These nucleoli, like those of the primary nucleus, also become opaque and yellowish, and each presents a single hyaline vacuole or circular area in its centre—sometimes more than one.

The nucleoli of the primary nucleus, after they have become distinct, soon unite and form one spherical nucleolus, with a single hyaline vacuole in its centre, thus assuming the form, which it first presents when the root has just budded forth from the root-cell of the embryo-sac. After this the nucleoli of the secondary nucleus also unite in the same way, and present the same spherical form when conjoined.

The primary nucleolus now becomes more opaque, sub-round or elongated, and presents a number of vacuoles of different sizes; while the septum has become fully formed and has taken on a sigmoid shape. Thus the second root-cell is completely cut off from the first.

3rd stage.—In this, the cell for the first bunch of rootlets is formed and provided with a nucleus; it commences in a convex, lateral projection of the first root-cell opposite the oblique sigmoid septum. The primary nucleus now disappears again and undergoes precisely the same changes as those which it did for providing the nucleus for the second root-cell, but its counterpart now appears in the protoplasm occupying the lateral projection, which also presents a faint septum dividing it from the remaining part of the fixed protoplasm, in which the primary nucleus is still imbedded.

As the third nucleus, or that of the lateral cell, becomes more defined, and its nucleoli unite together in the way just described, the septum becomes more evident, and at length, we have the lateral cell completely cut off from the first root-cell, and provided with its nucleus.

Vacuoles now appear in the fixed protoplasm surrounding the primary nucleus preparatory to its being broken down into the rotatory form.

4th stage.—Here the fixed protoplasm surrounding the primary nucleus becomes entirely broken down by the vacuoles, and the whole of it, blending with the adjoining rotatory portion, now flows freely with the latter, over the septum both of the second root and lateral or rootlet-cells. While this has been taking place, the primary nucleus has moved a little backwards, and has become permanently fixed to the protoplasmic sac, where the cell-wall has also become elliptically dilated, apparently to receive it. Vacuoles make their appearance in the midst of the protoplasm of the second root-cell near its septum; while this cell, now elongated, also gets a list to one side, from the increased development of the rootlet-cell.

The nucleus in the lateral cell now disappears and returns in the way before mentioned, viz. in two parts, each containing two nucleoli.

These undergo the same changes as those before described, ending in

a conjunction of the nucleoli of each nucleus. Meanwhile a longitudinal septum has become developed in the lateral cell, which is thus divided into two, respectively provided with nuclei.

The second root-cell has become more elongated, and the vacuoles have worked a cavity in it, round which the protoplasm is slowly rotating.

The lateral cell has become divided again by a transverse septum, which has been accompanied by a division of the nucleus and quadrisection of the nucleolus as before stated; so that there are now four divisions in the lateral cell, each of which presents a single nucleus with a single nucleolus, respectively formed in the way mentioned.

4th stage.—The second root-cell has reached the state of the first previous to the appearance of the secondary nucleus; each of the four lateral cells has become elongated, but in different degrees, as in the case of the roots developed from the root-cell of the embryo-sac; one or two in the latter are generally much longer than the others. Meanwhile the primary nucleus has become enlarged, has presented the vacuole in its mucus-contents to which I have alluded, and its nucleo-
[REDACTED] has become divided up into a number of small opaque nucleoli. These disappear and leave the old nucleus in the form of a flat, elliptical, structureless, effete piece of cellulose (?); or the nucleus becomes prolonged backwards in the form of a long cell, and the small nucleoli drawn out with it into different shapes and lengths. What becomes of the small nucleoli into which the nucleolus divides I am ignorant; whether they become absorbed, or whether they escape from the nucleus into the rotating protoplasm? Judging from what takes place in the cell of the plant-stem, the latter would seem to be their destination; but, whatever it may be, all trace of them ultimately disappears in the remaining portion of the nucleus.

Thus far, then, we have seen, that the second root-cell and root-cell developed from the first root-cell correspond, in development, with the first cell of the plant-stem and root-cell of the embryo-sac. Moreover, when the second root-cell is prolonged, it undergoes the same changes as the first cell, by which repetition, we seem to get further confirmation of what goes on in the embryo-sac before germination becomes evident. All that takes place previous to this, however, is completely shut out from us by the black, opaque colour of the middle coat of the *nucule*, which causes the early part of germination to be as invisible as the glassy transparency of the cell-wall of the root renders its development apparent. Hence, for all that occurs

antecedently, we must be guided by inference, and for views on this part of the subject, I can refer the reader to no higher authority than A. Braun, whose observations on the "Nucleus of the Characeæ" are among the papers which have been so happily selected and translated for the advancement of Botanical Science by Mr. Henfrey.* I would here, however, casually notice that the embryo-sac which turns blue under the action of iodine and sulphuric acid before germination, ceases to do so after the latter has commenced.

It may now be asked, What becomes of the nucleus when it disappears? In reply to which I can state no more than I have already done,—viz. that all it leaves behind is a clear space, corresponding to the form and size of its capsule or cell-wall, with some faint amorphous tissue in the centre, and that this space also soon becomes obliterated or filled up by the fixed protoplasm, after which no trace of the nucleus remains. Its coming into sight again, with its counterpart too, is so faint that it seems almost hopeless to endeavour to trace the changes between its disappearing and re-appearing again,—reduced in size and with double nucleoli, as I have before stated. Of this it is certain, that one part moves towards the free end of the root-cell, viz. the secondary nucleus, and the other part, viz. the primary part, retires from it, while the septum is formed between the two in the lighter space of the fixed protoplasm originally occupied by the primary nucleus before its disappearance. It is also worthy of remark that the part intended for the primary nucleus generally appears first, and its nucleoli unite together long before those of the secondary nucleus; while, although the opposite sometimes takes place, it is rare, for I have only observed it twice.

As regards the influence of the nucleus over the development of the new cells, it will now be evident that, if there be any, it must be derived in the first instance from the parent nucleus, for both the extremity of the second root-cell and the projection for the lateral or rootlet-cell take place before the disappearance of the primary nucleus for providing each of these parts with a new nucleus. But so soon as a trace of the septa respectively, cutting off these cells from the remaining portion of the fixed protoplasm, and, therefore, from the old or first root-cell, is visible, the new nuclei respectively also appear in their proper situations; after which the further development of the nuclei and septa progress *pari passu*. Thus the new cells are never entirely without a nucleus, which would thus appear to exert some influence, directly

* Ann. and Mag. Nat. Hist. vol. xii. p. 207.—1853.

or indirectly, over their development, for as soon as the *only* two new cells which the root-cell gives off are formed the old nucleus becomes effete. At the same time, the general functions of the cell do not depend on the nucleus, for the cell grows larger and the circulation of the rotatory protoplasm continues for an indefinite period after it has ceased to exist; the latter, apparently, with even greater activity than when it was in full operation. Whether a new cell-bud can originate a new nucleus for itself or go on growing to the extent of a nucleated cell without a nucleus, I am ignorant. But I am inclined to the opinion that it can do neither, and, therefore, opposed to the view I formerly expressed, when I knew less about the development of the roots of *Chara*, viz. that the root-cells of *Chara*, like the gemule-buds on the body of *Vorticella*, might be developed "independently of the cell-nucleus."* I should hesitate, therefore, to assert now, that we might state this with certainty even respecting *Vorticella*.

Why the nucleolus should quadruplicate while the capsule or "nuclear utricle" only (?) duplicates, and, when the division of the latter has been completed, the two nucleoli in each half should unite again into single nucleoli, I am also ignorant. That the nucleus in *Chara verticillata* does invariably undergo this process in the provisioning of nuclei for new cells, several single and several repeated serial sets of observations on different root-cells enable me to assert. So evident is this, that on one occasion the nucleoli of the secondary nucleus remained separate for five hours, during which they not only constantly changed their position, but grew larger, so that I thought they would never unite, and therefore watched for the time of their provisioning the *third* root-cell; when at the end of the fifth hour union commenced, and an hour afterwards was complete. Twelve hours after, this nucleolus also disappeared, and about an hour and a half from this time the oblique septum dividing the second from the third root-cell was just visible, with the parent nucleus and its counterpart on each side of it respectively. Can the conjugation of the nucleoli, if it may be so termed, have anything to do with the reproduction or restoration of the size of the nucleus, as in some species of *Spirogyra* and *Diatomeæ*, where the contents of two cells, which have been derived from an interseptal division of one, unite again to form the spore? The same kind of quadruplication of the nucleolus appears to take place in the formation of the plant-cell of *Chara*, judging from two instances which occurred to me; and in looking for this generally it may

* Ann. and Mag. Nat. Hist.—1856.

be remembered that, whenever double nucleoli are seen in the nuclear utricle of *Chara*, it is a sure sign of this process having taken place, for even if the parent nucleus is ever in such a condition, it is at that time invisible.

On one occasion I found two nuclei with their two nucleoli respectively ununited, in the axial fluid of the rotating protoplasm, while each nucleus was reduced to a clear transparent oblong cell; and on looking for the primary nucleus in its natural position, as well as for the nucleus of the rootlet-cell, the projection for which was already somewhat advanced, I found that they were both absent, while the presence of vacuoles in the protoplasm filling the projection for the rootlet-cell, which was not yet cut off from the parent, showed not only that this protoplasm was undergoing solution, but, also, that the development of the rootlet-cell had been arrested. No doubt, therefore, remained in my mind that the two nuclei in the axial fluid were the primary nucleus and the nucleus of the rootlet-cell. In these instances, the nucleoli were clearly seen, and they presented the form of spheres filled or lined with a semi-opaque, homogeneous, yellowish substance, in the centre of which, on the surface of each, was a circular hyaline area or vacuole. In the nucleus nearest the free end of the root-cell, whose nucleoli were separated for some distance from each other, a transparent cell round each nucleolus could be perceived, but this was not apparent in the nucleus which was furthest from the end of the root-cell, whose nucleoli were in contact. The position of these nuclei, away from their proper situations, does not seem inexplicable, when we remember the migrating power of this organ, the want of a septum to keep the nucleus of the root-cell in its place, and the vacuolar solution that the fixed protoplasm was undergoing in which they ought to have been imbedded; nor can the approximated state of the nucleoli in one nucleus and their separation in the other, coupled with their relative position in the cavity of the rotating protoplasm, fail to point out which was intended for the primary nucleus, and ~~whether~~ for that of the rootlet-cell. Thus these nuclei, being in the clear cavity of the axial fluid instead of in the fixed protoplasm, afforded a much better view of the condition they and their nucleoli would probably have been in, had they remained in their natural situations; and the duality of the nucleolus indicating a recent division of the mother nucleus, while the second cell had been provided, left, with what has been before stated, no doubt in my mind, that this must have been the second division of the primary nucleus for provisioning the rootlet-cell.

It is by no means uncommon, either, to find the nucleolus of the pri-

mary nucleus elongate and irregularly sub-dentate at the border, and half an hour afterwards to find it sub-round, and so on to change from elliptical to sub-round successively for several times, as before stated. I have also mentioned the appearance and disappearance of the vacuoles in it, which Nägeli calls "froth" (*loc. cit.*) ; and the evidence of locomotive power in the nucleus itself, or in what Nägeli calls the "nuclear utricle." I have, however, never seen any granular matter in it, neither have I ever seen any granular matter in the mucus-contents of the nucleus with the microscopic power mentioned, but, like the nucleolus, it presents vacuoles, though this is only preparatory to becoming effete. The nucleolus sometimes presents a grumous appearance, as before stated, but this is generally just before it disappears, and I am not certain whether it does not depend on an increase in the number of vacuoles.

Iodine makes the nucleolus contract and assume a deep brown-red colour, which yields to water. Sulphuric acid causes it to swell up and disappear instantly, leaving nothing but the nuclear utricle behind, unaffected ; just as when the nucleolus disappears preparatory to the formation of a new cell. If, however, a weak solution of iodine be first added so as only to contract the nucleolus slightly, the sulphuric acid does not act so rapidly, and then it may be seen to expand under the eye until its outline alone remains visible, with the vacuoles, which do not disappear under these circumstances. I have never been able to demonstrate a capsule round the nucleolus *in situ*, whether young or old, double or single, though I have tried in various ways to do so, from the deceptive appearance which it frequently presents of having one ; nevertheless, in the case mentioned where the nucleus was not *in situ*, a transparent capsule did appear to exist round each nucleolus. When the nucleolus becomes invisible or very faint under the action of sulphuric acid, iodine fails to restore its form or render it more distinct ; and in no instance have I ever been able to produce the characteristic blue colour of starch in any part of the nucleus.

We now come to the offices of the nucleus, of which nothing more is revealed to us in the development of the roots of *Chara*, than that, so long as new cells are to be budded forth from the one to which the nucleus belongs, the nucleus continues in active operation, but when this ceases it becomes effete ; while the rotation of the protoplasm and subsequent enlargement of the cell, &c. which is much better exemplified in the plant-stem than in the root-cell, goes on after the nucleus ceases to exist. Hence the development of the root-cells of *Chara* affords us nothing positive respecting the functions of this organ, and, therefore, if we wish to assign to it any uses in particular,

they must be derived from analogy with some other organism in which there is a similar nucleus whose office is known. Now, if for this purpose we may be allowed to compare the nucleus of *Chara* with that of the rhizopodous cell which inhabits its protoplasm, we shall find the two identical in elementary composition; that is, both consist at first of a "nuclear utricle," respectively enclosing a structureless, homogeneous nucleolus; the latter too, in both, is endowed with a low degree of movement. After this, however, the nucleolus of the *rhizopod* cell becomes granular and opaque, and, when under circumstances favourable for propagation, a new cell-wall is formed around the nuclear utricle, or this is an enlargement of the nuclear utricle itself, I do not know which; the granular substance of the nucleolus becomes circumscribed, and shows that it is surrounded by a spherical, capsular cell; the granules enlarge, separate, pass through the spherical capsule into the cavity of the "nuclear utricle"; a mass of protoplasm makes its appearance, and this divides up into monads, or, as I first called them, "gonidia."* The nucleolus of *Chara*, on the other hand, after having provided the two cells developed from its own root-cell, becomes stationary, and also divides up into a number of small, round, graniform nucleoli, which disappear in some way or other unknown to me, leaving the nuclear utricle, at least, effete. Whether these small nucleoli are ultimately dissolved or find their way into the rotating protoplasm, I am, as I have before stated, ignorant; but, so far as this multiple division goes, we have an analogous termination between the nuclei of these two organisms; and when we remember that the nucleus of the cell in which the *globule* of *Chara* originates must furnish all the cells with nuclei which bear respectively the antherozoids,—that these nuclei are very small, so small indeed that they are but granules in size, compared with the nuclei of the plant and root-cells,—it does not seem far-fetched to assume that the nucleus is an organ of generation.

Further, should it hereafter be proved that the rhizopodous cells are developments of *Chara* itself and not a foreign organism, it might not be found difficult to trace a connection between the so-called "gonidia" and the "spiral filaments." Thus *Chara*, in some forms, would then be an animal, and in others a vegetable, according to the distinction between *Chara* and *Amaba* which will presently be mentioned; for the rhizopodous cells do not produce the "gonidia" or monads until they have enclosed a portion of the cell-contents, after the manner of *Amaba* when taking its food. Again, I have already shown how the nucleus of the latter divides up into granules and cells producing new

* Ann. and Mag. Nat. Hist. vol. xvii. p. 101.—1856.

beings, and how it becomes lost in the development of the ovules,* and Stein has shown that the nucleus of *Vorticella* becomes divided up into cells to produce a new litter; also that it shrinks into a small elliptical effete mass of fine granules in the development of *Acinetæ* through the *Acinetæ-form*, which I have frequently been able to confirm. So that, if the nucleus in *Amaeba* and *Vorticella* be identical with that of *Chara*, we shall probably not be far wrong in assigning a generative power to it generally, that is, through duplication in common reproduction and through multiple division in the true process of generation. We must, therefore, if we adopt these views, regard the nucleus of the *globule* as merely a modification of that of the cells of *Chara* generally, to meet the requirements of the case; and hence as a subordinate organ, which, together with the other parts of the protoplasm, is subject to a common developmental power. It has already been stated that the nucleus perishes as soon as its functions cease, while the cell to which it belonged goes on growing. Thus the internode of the large *Nitella* of Bombay, which may be half a foot long, loses its nucleus, probably, when, as a cell, it does not exceed the 100th part of an inch, for the nucleus disappears long before the layer of green-cells is formed.

It has not, however, been shown what becomes of the small nucleoli of the effete nucleus; and perhaps it would be as well not to assume that no more new cells can be formed after this takes place; for, if the cortical layer of cells is ever added to the first internodes and branches of the young plant of *Chara verticillata*, which I have already stated to commence in the simple form of *Nitella*, it must be some time after the nucleus has ceased to appear in its ordinary form or as a whole; for at present I have a dozen plants with the *nucleus* attached to them respectively, and each plant about one-third of an inch in length, without the least appearance of cortical cells, although each is composed of three or four internodes and several branches; if the cortical cells appear hereafter, they may, perhaps, be formed like the other cells, viz. by projections of the mother cell-wall, in the form of grooves, which, lodging a portion of protoplasm, are ultimately cut off from the parent cell or internode; in which case they must be provided with nuclei from the remnants of the old nucleolus, or nuclei altogether *de novo*.

While the component parts of the first cell of the root of *Chara* are still fresh in the mind of the reader, it seems advisable that they should be compared with those of *Amaeba*. *Chara* lives by nutriment obtained

* This vol. p. 451.

through endosmosis; *Amœba*, by taking in the crude material direct, and, having abstracted the nutritious parts by the process of digestion, throwing off the refuse. *Chara* is a vegetable, though there are animal cells which also live by endosmose, but *Amœba* cannot be a vegetable if we admit the distinction that I have given, viz. the taking in of crude material. Nevertheless the root-cell of *Chara* and *Amœba* greatly resemble each other.

Thus the cell-wall of the former corresponds to the pellicular secretion or capsule of *Amœba*, which, in *Arcella*, &c. appears as a shell. The protoplasmic sac may correspond to the pellicula itself and diaphane. The nucleus is identical, and situated in the fixed portion of the protoplasm, as it appears in the fixed molecular sarcode of *Amœba*, when the latter assumes a spherical form. (In my notes on the organisation of the Infusoria,* I have called the "nuclear utricle" the "capsule" and the "nucleolus" the "nucleus.") The "granules" of the fixed protoplasm have exactly the same greenish tint and appearance that the "granules" of the sarcode in *Amœba* present, and the former appear to be vicarious in function if not homologous with the green cell of the plant-stem, that is, when the former make their appearance the latter disappear. The rotating protoplasm corresponds with the internal mucus of *Amœba*, to which I would confine the term "sarcode,"† and the vacuoles to the vesicula and vacuoles of the substance of *Amœba*; hence it would appear that, as a cavity is formed in the protoplasm of the cell of *Chara* by the bursting of the vacuoles into each other, round which the rotating protoplasm turns, so it may be the vesicula which thus becomes distended in *Amœba* to render it spherical, and hence the appearance of the fixed sarcode on one side of it in which the nucleus is imbedded. That the vesicula, when greatly distended, does render some of the infusoria spherical, may easily be seen by the state in which *Plæsconia* and *Vorticella* burst from their cysts respectively when the vesicula is expanded to the utmost to produce the rent, and then subsiding after the animalcule has effected its escape, thus allows of its returning to its natural form; and it is not unreasonable to infer that the same thing takes place in *Amœba*, to render its plane form spherical, and vice versa. Nor should we omit, in this analogy, the vacuolation which takes place in the protoplasm of *Chara* just before the cell dies or when it is weakened by disease or injury, which is a common occurrence with the vesicula and its vacuolar system in *Amœba* and other infusoria under similar circumstances.

* This vol. p. 446. † *Idem*. See the definition of these terms, p. 420 *et seq.*

‡ *Idem*. See remarks on this point, p. 445.

The most interesting point, however, which this analogy brings forth is the correspondence between the rotatory motion of the protoplasm in the cell of *Chara*, and that of the sarcode of *Amaeba* and other infusoria; since, by considering this motion in different organisms, we may perhaps come by some notion of the cause by which it is produced in all. In the Planarieæ and Rotatoria, the lash of cilia, which projects from the hepatic cells that line the stomachs of these animalcules respectively, rotates the food during the process of digestion; but in the second part of the alimentary canal of the Rotatoria, where there are no hepatic cells, the surface is seen, on the approach of anything into it, to be covered with cilia. Again, in *Vorticella* and *Paramecium aurelia*, the digestive globules also are slowly circulated round the abdominal cavity, if I may so term it, in the midst of the sarcode or internal mucus; and when we watch this circulation narrowly, to wit, in the posterior part of *Vaginicola crystallina* (Ehr.), we see that the bodies in which the chief motion exists are very minute and apparently stationary, and that, while their movements are very rapid, the circulation of the pellets of food is very slow, hence they would appear to be cilia. The same kind of circulation occurs in *Amaeba*, but is so tardy, while this infusorium is so incessantly changing its shape, that it is not seen under ordinary circumstances. The movements of the rotating protoplasm in the Characeæ is also very slow; for, when it is viewed in the long internodes of *Nitella* with a very low power, or even with the naked eye, it seems hardly to move faster than the foot of a gasteropod; still there is no positive evidence that it moves round the cell after the manner of the latter, although it would appear to possess the power of movement *per se*. Hence the question remains undecided, viz. whether it moves round the cell by itself, or by the aid of cilia disposed on the inner surface of the protoplasmic sac, in like manner to those which appear to exist in the abdominal cavity of *Vaginicola crystallina*, and which have been seen and drawn by the Hon. and Rev. S. G. Osborne, confirmed by Mr. Jabez Hogg, in *Closterium Lunula*.*

It might now be said by some that, in the present state of our knowledge, the comparison between a plant and an animal is not allowable; but the answer to this respecting *Amaeba* is that there is nothing on the animal side of this organism that offers for comparison equal to the organisms on its vegetable side, taking it even generally or particularly. Again, it might be said that I was formerly of opinion that the rotating protoplasm circulated round the cell by itself; but I was then not aware of the existence of the protoplasmic sac or a

* Quart. Jl. Microscop. Soc. vol. ii. p. 234.—1854.

fixed membrane inside the root-cell, on the apparent absence of which this view was chiefly grounded. Lastly, it might be said that I formerly tried to prove that the "gonidia" developed from the rhizopodous cells of the protoplasm were the offspring of a parasite, and now I have hinted that they may be found to be developments of *Chara* itself. Proof of the latter, however, is very remote, but when we find that there exists an intimate analogy between the nucleus of the cell of *Chara* and that of this rhizopodous cell, as well as that of *Amaeba*, &c. both in form and, probably, offices, and that the nucleus of the rhizopodous cell divides up into granules for the production of the "gonidia" or monads, it does not seem to me an unpardonable amount of speculation to think for a moment that the nuclei of this organism, which exist free and in their proper cells in the protoplasm of the internode of *Chara*, may be derived from those into which the nucleolus of *Chara* ultimately becomes resolved.

ART. XI.—*Notices, Historical and Antiquarian, of Places in Sind.* Communicated by H. B. E. FRERE, Esq., Commissioner in Sind.

Read 8th March 1855.

Oomurkot and its Soda Princes. By VISHWANATH NARRAIN.

Oomurkot, so named after its founder Oomur, one of the Soomras, was built probably more than five hundred years ago. The Soomras held the place for about a hundred and fifty years, and were succeeded in the sovereignty of it by a warrior tribe, the Sodhas.

The Sodhas (or Sodas) are a branch of the great Parmar race, which has spread, at different periods and in the numerous revolutions of former days, from that cradle of all the Kshatree tribes,—the Province of Central India. Under various names this tribe has from remote times held sway in different parts of Central India and the adjoining countries.

One of these Parmars, named Bahudra (or Bahudrao), lived at Balmeer about 450 years ago. He was succeeded by his son Chhahudrao, who removed from Balmeer to Seew in Marwar. Chhahudrao had two sons, Sodha and Sankhlo, and one daughter, Sichya. The first of these made an expedition against Ruttakot (so called after a Moghul Rutto, its founder), and conquered it. Tradition relates that when Sodha killed

the Moghul Rutto, his head, severed from the body, bounded down twenty-five steps from the threshold of his palace, and there stopping exclaimed, "Your descendants shall reign for only twenty-five generations," a prediction which the people of the place (Oomurkot) consider fulfilled, inasmuch as they make out a list of twenty-five princes of the Sodha dynasty from the first Parmar Bahudrao.

Sodha, after taking possession of Ruttakot, transferred thither his seat of government from Marwar. The ruins of Ruttakot are still to be seen on a sandhill which forms an island in the Eastern Narra, about twenty-five miles NW. of Oomurkot, and ten SE. from Khipra. It is between two small hamlets of Dilyear and Bhaeetee-ki-Bhit, and about three miles from each. The only remains are heaps of burnt bricks covering a large mound. The bricks are of great size, fourteen inches by nine, and proportionately thick. Perhaps excavations and future research may bring to light in Ruttakot a second Brahminabad.

Sodha, as we said before, had removed his seat of government to Ruttakot, which was subsequently given up for Oomurkot, where they displaced and succeeded the Soomras about 350 years ago.

Sodha left his throne and possessions to his descendants, who, after his time, were no longer known as Parmars, but Sodhas or Sodas. The following is a list of Sodha Princes at Oomurkot, as found on the books of a local bard.

The first part gives the three Parmar princes, viz. the grandfather and father of Sodha, and the chief himself; and the second, Sodha and his descendants.

I.—*Parmars.*

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|----------------------|---------------|
| 1. Bahudra (or Rao). | 3. Sodha Rao. |
| 2. Chhahudrao. | |

II.—*Sodas at Oomurkot.*

- | | |
|---|------------------------------|
| 1. Sodha Rao (the same as
above 3*). | 12. Veeso Rana. |
| 2. Chachucklerao. | 13. Tejsee Rana. |
| 3. Je Brumhurao. | 14. Champo Rana. |
| 4. Jeshudhrao. | 15. Gango Rana. |
| 5. Someshwur Rao. | 16. Soortan Rana. |
| 6. Dhara Yureeshe Rao. | 17. Ashkurn Rana. |
| 7. Doojunsul Rao. | 18. Kesursing Rana. |
| 8. Khirorao. | 19. Khimraj Rana, |
| 9. Avutarnde Rao. | 20. Sngram Rana. |
| 10. Thero Rao. | 21. Shrivraj Rana. |
| 11. Ilumeer Rana. | 22. Subulsing Rana. |
| | 23. Mehraj Rana, now living. |

The Soda princes were at first called Raos, but the title was changed in the time of Soda Humeer, who had the title of Rana bestowed on him by the celebrated Akbur, who was born near Oomurkot during his father's flight towards Persia through Sind and Affghanistan. The title has descended in the family to the present day.

Although the Sodas have, since the founder of their dynasty, retained a hold over Oomurkot and its surrounding districts, the sovereignty passed through different hands in later times. Thus, in A. C. 1746 Noor Mahomud Kalhora conquered the Sodas, and established his supremacy there. He demolished an old fortress and erected a fort. It stands on a sandhill on the edge of the desert, overlooking the vast plains of Sind, which extend from this spot in one unbroken level to the Indus, a distance of from eighty to a hundred miles. The fort is at present in a very dilapidated condition. The traces of a canal, by which, it is said, the stones for the fort were brought from Southern Sind, are still to be found on the plain below the fort. The stones, many of which are still covered with oysters and barnacles, are of the arenaceous limestone, and limestone conglomerate, common in Lower Sind. The canal is said to extend to Wanga Bazar, and probably communicated with the Lukhput Kharee.

About half a mile NE. of the fort is still shown the spot where the Emperor Akbur the Great was born, as tradition states, in the open air under an "akh" bush (*Asclepias gigantea*), the only shelter his parents could find in their flight. "There could be no doubt of the fact," our informant, an intelligent old Sindee, stated, "as there was the 'akh' bush, and the emperor's name was Akbur," though etymologists will perhaps hardly agree with him; and, as the Ranas of Oomurkot assert that they obtained their title as a mark of the emperor's gratitude for hospitality shown to his parents at the time of his birth, they were probably not quite so destitute of accommodation.

During the time of the Kalhoras, the Sodas had charge of the revenue collections, the Kalhoras contenting themselves with a mere controlling power. One of these latter, Abdool Nubee, fell out with the Talpoors, and, himself unable to be avenged on them, sought assistance from the King of Cabool, to whom the country was then tributary. The consequence was the despatch of a large force from that quarter, which devastated the country, and returned without accomplishing anything. This is said to have been in A. C. 1782. During the same year another force from Jodpoor, where Rana Vijayasing then reigned, came at the invitation of another Kalhora prince; but, instead of

helping the Kalhoras against the Talpoors, they took possession of Oomurkot in their own king's name.

Oomurkot thus remained subject to Jodpoor until A. C. 1813, when the Talpoors attacked and conquered it. This happened at the time of Meer Kurum Alee Mahomed Alee in Sind and Raja Mansing at Jodpoor. From the Talpoors the birthplace of Akbur has, of course, come into the hands of the British, with the rest of Sind.

The population of the Oomurkot Talooka appears from the last census to consist of 20,485 souls. The number of houses is 5,045. Oomurkot itself is a small Thurr town with 556 houses, and a population of 2,755 inhabitants. The style of houses is such as generally prevails in Sind. They are mud-roofed and very poor looking, and the streets very dirty. The beehive-shaped hut, which is universal throughout the desert, is seldom seen in Oomurkot itself, though common in the neighbourhood.

The majority of the people of Oomurkot are Hindoos. Their style of dress is nearly a mixture of Marwaree and Sindee; as also their dialect, which largely draws upon the Marwaree from the contiguity of that frontier.

Oomurkot is the chief commercial town in the Thurr, trade being carried on through it with Kutch and Guzerat on the one side, and Marwar on the other. The principal staples are cotton and grain, but there are also various native dyed stuffs dealt in in small quantities.

The Ruins of Mehmetoor. By F. PHILLIPS, Esq.

Shahkapoor, anciently called Mehmetoor, is situated in the southern part of the Shah Bundur district, and about ten miles south-east of Meerpoor Buttor, the chief town of the Zillah.

The present village consists of not more than fifty houses, situated on a large watercourse, called the Old Goongra, to distinguish it from the stream of the same name flowing through another part of the country. Close round this watercourse and the present modern village commence the ruins of Ancient Mehmetoor, which extend for upwards of three miles, in a south and south-easterly direction. They consist for the most part of burnt brick mounds of different dimensions, which stand in the plain perfectly isolated from each other, and are visible from a great distance. The largest mound is situated close to the existing village, and is about three hundred yards in circumference, and perhaps sixty feet in height. This has not been opened as yet. In places are seen large blocks of stone, which have, apparently, formed the foundations of buildings, and there is also a small bury-

ing ground containing a few tombs of carved sandstone, put together, as is common in Sind, without mortar. These, however, possess no inscription whereby to judge of their age, or the names of those whose memory they were intended to perpetuate.

From the general appearance of the mounds I should say they are the remains of the principal buildings of the ancient city, the intermediate and more humble habitations of the poorer classes, probably of clay and earth, having disappeared in the lapse of time. There are no appearances of any fortifications in any direction.

Hitherto but few of the mounds have been opened, owing to the small success which has resulted from the operation. The excavations carried out have been made by sinking shafts and carrying the cut along all walls found in the ruins; the contents of the space so included have then been dug up and sifted, but, as already stated, with small results; one silver coin only, lately sent to the Commissioner of Sind, has been found. The other reliques consist of fragments of cornelian, agate, and other stones (apparently evincing that many lapidaries formerly resided in the place), and a large number of old copper coins, very small in size, and all so corroded that no inscription or legend, if any existed, is now to be traced; on some of the stones may still be seen faint traces of Arabic character, but not so distinctly as to convey a correct idea of their meaning. Specimens of all these have already been forwarded, and it is intended, during the next cold season, to continue the search, with the view of throwing some light on the history of this place.

The present village is called Shahkapoor (King's Town), after the famous Kutch saint, Shahfuttoo, who travelled through this part of Sind about two hundred years ago. Of the ancient city, Mehmetoor, nothing positive is known, and the following brief account has been gleaned from personal inquiry among the natives of this part of the country.

Mehmetoor, it is said, was originally founded by Mahomed Pyeem Soomra, the first of that tribe who reigned over Lower Sind. This will, I think, take us back to the fourteenth or early part of the fifteenth century. The city then, the tradition goes, stood on the banks of the Indus itself, and, indeed, the marks which still remain show that the old Goongra, now a nearly dried-up channel, must once have been at least a very considerable branch of the river, if not the main stream itself. The next chief named is Humeer Soomra, who must have been paramount late down in the line. The ruins of his palace, the large mound near the modern village, already alluded to, are still called by his name,

and pointed out by the peasantry. He died leaving two sons, by name Doda and Chumeesa, of whom Doda, the younger, usurped the throne. The elder brother, it is said, on this fled to Delhi, to lay his complaint before the reigning Emperor, Allahooden, and implored assistance. This was granted, and a force sent back to assist in recovering the lost throne. The brothers joined battle about ten miles from Mehmetoor, at a place called Kerree, which is still pointed out by the natives. Both were killed in the battle, and the Soomra army totally defeated. The Delhi force, the tradition goes, then marched on and sacked and burnt the city, which never again recovered the blow, and Mehmetoor or Shahkapoor thus ceased to be the seat of power.

ART. XII.—*Description of the Caves of Bâgh, in Râth.* By
E. IMPEY, Esq.

Read 28th December 1854.

UPWARDS of thirty-five years have elapsed since Lieutenant Dangerfield published, in the second volume of the Transactions of the Literary Society of Bombay, his description of the Caves of Bâgh, and though it has met at the hands of every antiquarian its meed of undoubted praise, so little has been thought of the Caves themselves that, in all notices and allusions to them by authors, a few lines, and those not without error, have served to fix their situation, number, size, and objects of worship, to all and each of which some amount of correction has become necessary on closer inspection.

Whether the confident but partial references thus made to them, or the unfrequented and secluded situation of the Caves, has deterred travellers from satisfying themselves on the above points, is not of much moment, but certain it is that few persons, beyond the officers of regiments in the neighbourhood, have thought it worth while to judge for themselves, and thus the three largest and, in some respects, most remarkable monastic caves in India have remained almost unknown.

In physics as well as in ethics the first error is in most cases reckoned the worst, and perhaps the geographical position given to the Caves has, more than any other, prevented their being sought for, and misled inquirers.

Whence it arose or with whom is not very material, but Mr. Ferguson and subsequently others have assigned to them the Valley of the Tapti instead of the Nerbudda, which is equivalent to interposing a distance of nearly 100 miles, and in that space a range of Ghâts in which no caves whatsoever have as yet been found; enough, it will be admitted, to deter most explorers, unless well acquainted with the topography of Western India, for I question whether even the name of the town of Bâgh is known to a single individual on the banks of the Tapti.

I have not, unfortunately, Mr. Erskine's paper, nor have I seen it for several years; the work in which it appeared (*Transactions of the Literary Society of Bombay*) is excessively scarce, and out of the reach of reference, being only to be found in libraries; I cannot, therefore, state precisely how many caves he entered or described, but, as well as my memory serves me, he supposed them to be four or five, of which two were said to be in ruins. There are, however, in reality eight, and the remains of another distinct set about a mile distant.

As may be said of all known excavations, none are in a perfect condition; but at Bâgh in particular, from having been dug out of a soft friable sandstone, they are in some places very much dilapidated and visibly crumbling daily, which makes it the more necessary that as accurate an account as possible be recorded of them before they are altogether destroyed.

Although, from Mr. Erskine's note appended to Captain Dangerfield's description, there was little doubt of the religious character of the Caves, the names under which they have been described and are locally known, viz. Pânc Pandoo, and, I fancy, still more the representation of five figures instead of eight by Captain Dangerfield, have misled a very eminent authority on Bhuddism (Mr. B. Hogson) into the belief that the Caves were dedicated to the Pânc Buddha Dhyâni of the Nepalese—the celestial and exalted but quiescent Eons of Adi Buddha, which I take to be equivalent to as many principal attributes of the Supreme Being. But independent of differences in detail, the images of the five (at least four) Dhyâni Buddhas being always placed in niches opposite the cardinal points at the base of Chaityâs, and their having unmistakably distinctive characters, such as differences in the position of the hands and nature of the particular cognizances and supporters, there is in reality but one, at the most, two figures of Buddha sculptured at Bâgh, the other figures being decidedly subordinate, while the object of worship in all the caves, without exception, is the Daglob. The figures on the screens on each side of the vestibule are exactly similar except as to height, and it is the central figure alone which is

applicable to Buddha. Those on each side of him are attendants and Chowree bearers. The two others in the niches flanking the entrance to the Daghab chamber are Dwarpals, or, at the most, Buddhisutwas, who will be more appropriately and minutely described in detail. It is scarcely necessary to remark that the local name and traditional connection of the Caves with those fabulous heroes, the Pandoos, have no foundation. Setting aside the fact of their era being nearly two thousand years earlier, their images have never, to my knowledge, been met as objects of adoration, and there is certainly not the least resemblance in the figures at Bágħ to the qualities the Pandoos are said to have embodied.

In addition to the errors regarding the figures, the size of the Caves at Bágħ has also been underrated. The largest is stated to be 80 feet by 60 feet and a 20-pillar cave; it is in reality 94 feet square and a 28-pillar cave, vieing, if not exceeding in magnificence, No. 3 of the Adjunta series, while the two other Vihars are still larger than any others as yet discovered, being 86 and 88 feet square. I give a memorandum of the respective Caves to exhibit this:—

No. 16 Adjunta.....	67	\times	65½	feet.
No. 17 ditto	64	\times	63	"
No. 1 ditto	64	feet	square.	
No. 3 ditto	91	"	"	
Keneri Vihār	96	\times	42	feet.
Bágħ	94	feet	square.	
Ditto	88	"	"	
Ditto	86	"	"	

Ellora Derhwara.....110 \times 70 feet. This includes the side cells, for which at least 18 feet should be deducted, which leaves 92 feet, and reduces it to less than the Bágħ Caves, besides being a combination of a Vihar and schoolroom, which at Bágħ are separate and distinct.

It will be admitted that there are in the above discrepancies sufficient to warrant a second description of the Bágħ Caves, notwithstanding the lapse of a quarter of a century; the more so as they are remarkable for a completeness and grandeur almost unknown in any other series, not excepting Adjunta. Of these I may mention evidences of a colonnaded verandah 220 feet in frontage length, and a dome or centring in the chief Vihar, an entirely new feature.

The following will not therefore, I hope, be regarded as a critique upon any preceding account or notice of these Caves; and if I have occasion to refer most frequently to Mr. Ferguson, it is because he is

the latest, the most eminent, and, generally, the most correct writer on Indian architecture, Buddhistical in particular, and by his inability to visit the Bâgh Caves there has passed the most favourable opportunity of being recorded the best illustration and most graphic account which a close intimacy with Buddhistical research could produce, instead of which, in the text which accompanies Mr. Ferguson's illustrations, half a page only is devoted to Bâgh.

With the exception of the Caves being placed in the Valley of the Tapti, the topographical description of them, as originally given by Lieutenant Dangerfield, is very accurate. The Purgunna and town of Bâgh are situated in the district of Râth, a hilly tract of country below the Vindhya Chain, constituting the intermediate steppe, both in point of elevation and geological formation, between Malwa and Guzerat. It is about 850 feet above the level of the sea, and as many below the range in question. The town from which the Caves derive their name, as understood by Europeans (for they are commonly known as the Pâñch Pandoo by natives), is in lat. $22^{\circ} 26' N.$, long. $75^{\circ} E.$, and is remarkable for nothing else except some iron mines, rich in ore, but undersold by the same metal imported from Europe. It has for some years belonged to Sindia, who manages it by deputy. Perhaps the only additional point of interest connected with its locality is its accessibility. From Oogain it is between 90 and 100 miles distant, and the same from Indore, to which the road runs via Dhar and the Tanda Ghât, that is, for travellers going westward. In coming from Khandeish or Nimar it is about 60 miles off the direct road, whether approached from Julwana near Sindwa, at the top of the Satpoora Range, or from Akbarpore on the Nerbudda. In the former case the route is via Rajpore and Chikulda, and in the latter by Dhurumpooree and Bakaneer to Chikulda, towns and places well known in the neighbourhood around.

From the town of Bâgh the Caves are distant between two and three miles, on the NW. face of a low range of hills rising from the bank of the Coree Wagree river. These hills deserve a little notice, as it is to their peculiar constitution the destruction of the Caves is owing. They are the first and only indications of the sedimentary rocks met in this direction below and close to the Vindhya Range, which is entirely volcanic, and they do not extend above a very few miles in length and breadth.

Imposed on the older red sandstone, they are themselves composed of layers of the soft and more recent formation of the same nature, varying both in colour and hardness according to the degree of im-

pregnancy with iron, which seems to have imparted firmness and consistence wherever it has intermingled with it. This it does not seem to have done generally in beds of any depth, but in patches and layers and veins in a variegated way.

The colour of the sandstone is consequently in some places as dark as copper, in others but slightly reddish, which is the hardest and finest variety, and also lies *superior* to the pure white, which is soft and coarse and underneath.

Superimposed on the sandstone is a deep stratum of white clay or claystone, in places full 20 feet in depth, and it is evidently owing to the absorbent and retentive power of this clay, and the weight as well as the destructive effect of the water contained in it, that such immense flaky masses of the roofs and verandahs have been precipitated and fallen in. This does not appear to have acted on all the Caves alike, both from the unequal depth of clay, and the texture of the underlying stone, which seems to be most compact in the first Cave (hence its preservation), and least so in the last and most southerly ; but, as stated, to this element alone is to be attributed the damage and injury the Caves have sustained.

The hill is about 150 feet in height in the most elevated spot, which is over the first Cave, and its direction E. 40° N., that is nearly NE. and SW : the aspect of the Caves is consequently NW., making allowance for their sweep, which follows the course of the river or stream, from which they are nowhere 100 yards distant. The light, therefore, which they received was not at any time the full force of the sun, which is never to the north in this latitude beyond a very few weeks in the year.

The Ooree Wagree river is a tributary to the Nerbudda, and though of considerable width where it debouches into that river, is very insignificant at Bâgh, except in the monsoon. In the hot weather it is said to be quite dry, and there do not appear to be any reservoirs or bunds in the course of it from which the monasteries could have been supplied.

The Caves, like most others, are excavated right in the centre of the hill's face; that known as the first (and of which a drawing is given by Lieutenant Dangerfield), but that only, is approached by a flight of steps broken by a little constructed parapet. The former commence about thirty paces from the bank of the stream, and are now flanked by large tamarind and bale trees.

The series consists of three large Vihars with their usual cells, but each Vihar has also an attendant set of dwellings larger than the cave

cells, and differently arranged, which seem to have been meant for titular superiors or elders. To the central and chief Vihar there is, in addition to the above (in one continuous façade 220 feet in length and embraced by the same verandah) a large Shala or schoolroom 94 feet long, with which the large and peculiar Caves referred to are connected by a wide passage and doorway. These will be best seen by turning to the ground-plan, and evince not only the peculiarity but the magnificence and completeness with which the Caves were finished. There is, besides the foregoing, a large detached Griha about a quarter of a mile to the south, which I accidentally fell in with.

The set do not occupy an unbroken line or present a continuous front, but are interrupted by curves and bends in the hill which would seem to have been unequally favourable for excavation, and this would almost suggest the idea of successive operations. The actual frontage in feet is close on 1,000, extending over a mile in length, including the Griha or superior's cell to the extreme south.

Commencing with the next to this, and usually the first entered, it would appear, from being hidden from below by trees, to be deep in the hill, and to have been excavated disadvantageously under its face, which is only 25 feet from the uppermost step; but this is deceptive, for there are distinct vestiges of an outer verandah and vestibule, which must have approached the verge of the landing-place, and been originally visible from below.

The front of this Cave is a good deal blocked up with the fallen fragments of the roof of this verandah, and the entire left half by a modern Byragee's Chabootra. There are, however, still remaining several bases of pillars at given distances, indicative of the existence of the former, also the chapels at each extremity.

Still exterior, however, even to the verandah, are the remains of the vestibule or porch in the centre, and at either end a small recess; that to the right contains a very modern figure of Gunesh, but, to counterbalance and display the posterior occupation of the lower chamber indicated by this, there is above it the Buddhistical emblem, the arched dome and spire, with flying figures holding garlands. On the left the primitive figures are intact and more in detail. There, Buddh is seated on a bench with one leg (the left) under him, the other bent and the foot on the ground, the right hand on the right thigh with the elbow bent, the left on the thigh of the same side but straight along it. On either side of him are traces of Chowree bearers, and above him the emblem as in the right. These recesses were evidently the outermost sculptures projecting beyond the verandah, and do not appear

to have been connected except by a raised flooring. The chapels belonging to the verandah, on the contrary, have had pillars lengthways between them, the bases of several (6 feet apart and the same in diameter) being plainly perceptible among the *débris* of the roof.

The exterior plan of this Cave, therefore, differs from those at Adjunta in having recesses exterior to the verandah, which itself has been a colonnade, and these must be added to the ground plan, as will be noticed on referring to the latter; the other Vihars at Bâgh are precisely similar in this respect.

Instead of two doors, as has been imagined and described by Lieut. Dangerfield, there have been five to this Cave, which must have afforded ample light to the interior originally, though at present the left half is obstructed by the Fukeer's Chabootra referred to; this is quite perceptible from the interior.

The centre door is 13 feet \times 11 with five lintels receding to 10 \times 5 $\frac{1}{2}$, the inner round; at the base have been two tigers couchant. The side doors decrease in height and size, as they are distant from the centre, to 8 feet \times 4 in width. The centre door by its height and width must have thrown the light full on the vestibule, its screens, and the Daghob, and also the central hall. The next door, being between the fourth and fifth row of pillars, lit them, while the side door performed that office for the aisles and entrances of the cells and side chapels at the extreme end; there was, therefore, no imperfection or want in this respect.

The front of this Cave has been roughly plastered over but not ornamented in any way, and the only part which has been is the roof, hall, and aisles, now defaced with smoke.

The interior of the Cave is 88 feet square, and its plan corresponds with that of Buddhistical Vihars generally. The aisle, 12 feet wide, runs entirely round, leaving a central space of 64 feet; a platform is raised on the border of this, 6 feet in width, on which six rows of pillars (each way) are erected (counting the corner ones twice), with corresponding pilasters on the side walls, making it a twenty-pillar Cave. The central area is about 50 feet square, and is here occupied by four round pillars, reeded spirally, and considered necessary, I presume, in consequence of the softness of the roof, but so far not singular that No. 11 of Adjunta has a similar arrangement.

On the top of the pillars a cross raft or beam is cut about a foot in depth. The roof of the Cave is consequently so much higher absolutely, and by descending a step into the Cave, and the platform pediment of the pillars only extending over their diameter, nearly 3 feet is added

to the actual height, which is 14 feet, the pillars being 11. This appearance of beams and rafts would give the idea of its having been borrowed from some wooden or structural edifice, and that either of two stories or of flat construction.

The pillars in these Caves all differ, but are traceable to one prevailing idea, viz. varieties of the square, except those in the centre, which are round. In cave architecture the usual divisions of a column are for the most part so indistinct and so lost by the ornamentation that it is impossible to fix a diameter, but, taking as the shaft that which has the largest proportion of the height of one form above the plinth, the diameter would be 5 feet, and higher up about 4 feet. The entire height being 11 feet, one bears no known proportion to the other.

The general order is a small pedestal of one foot in height, consisting of the plinth, one moulding (a torus), and cornice; upon this a low shaft rises by a square $3\frac{1}{2}$ to 4 feet in height, which then changes to a dodecagon for 3 feet, is succeeded by a spiral reeding for $1\frac{1}{2}$ foot, and again by a dodecagon for 1 foot: above this latter is the abacus, on which are imposed bracket-architraves which reach in space to one half the diameter. The intercolumniation (if such it can be termed) is therefore as nearly as possible pycnostyle. There are of course deviations from the above, but always in, upon, and above the square part or shafts; for instance, above the reeding are polygons changing to dodecagons, or else the reeding is omitted and octagons and polygons vary the effect.

There are twenty cells in the Cave, seven on each side and six in rear, inclusive of the verandah chapels; they are 9 feet square, have jambs and a recess cut in each in the wall; each cell corresponds to an intercolumniation, and one to the aisle at the four corners. In the rear centre the vestibule leading to the Daghab chamber occupies the space of three cells. This vestibule is 26 feet by 12, open in its whole length, with the exception of two plain octagonal pillars in front. It is in the vestibule that the colossal figures are carved: as they require descriptive detail, I proceed here with the plan of the Caves.

Leading from the centre of the vestibule is a large doorway 15 feet \times 6, directly opposite to which, within a chamber 20 \times 18 and 17 high, stands the Daghab, or object of worship. It is taller and larger than in most caves, and has a hexagonal plinth for one-third of its height; above it a circular band of about 4 feet and 28 in circumference is cut, and from that the dome springs surmounted by a Tee which touches the roof. It is plain, that is, not ornamented with figures of Bhooda or inferior divinities, and merely interrupted by a few astragals, &c.

In the side walls of the chamber, at $9\frac{1}{2}$ feet from the ground, are long low recesses—receptacles, most probably, for valuables.

From one of the left-hand cells of this Cave a series of chambers, of which five remain, have evidently led up to the top of the hill and been the private entrance. The extreme length of the excavation of the Cave in the depth of the hill is 150 feet.

For all distinctive purposes the drawings of Captain Dangerfield, of the figures and screen of the vestibule, are significant of the general nature of the sculptures, but, as far as my recollection serves me, they give indefinite ideas of the individual characters of each. There are two groups of three figures forming a screen at each extremity of the vestibule, and also a figure meant as Dwarfal, or warder, on each side of the doorway or entrance to the Daghab chamber. These latter differ from one another as well as from the groups of the screens.

The latter are coloured and cut in *alto reliefo*, and resemble one another so closely that one description will suffice for both, as the actual differences are very slight.

The figures on the left-hand screen are about one foot smaller, are better carved, and look inwards towards the Daghab, those to the right outwards; all are clothed and cut in a recess which encircles the group. They are raised a cubit from the ground, and, besides this, stand on an expanded lotus which adds half a foot more to their height.

The centre figure is the tallest, $9\frac{1}{2}$ feet to the top of the hair in addition to the foregoing measurement. The right-hand figure near him is $8\frac{1}{2}$ feet, and the left $7\frac{1}{2}$. The largest is evidently a Buddh-sutwa expounding doctrine; he is in the same attitude exactly as in the side screens of the Chaitya Cave at Keneri, standing erect, his right hand extended, its palm open, and the body half turned to the observer, while the left is bent upwards upon the shoulder of the same side, and holds up his garment, which falls in folds down his side, crossing at the ankles. The same figure is seen on the Stambhas at Sanchi.

His hair is short and curled, his face contemplative, with a short neck, and pendent earrings not touching the shoulders, which Jain images most frequently do; excepting this there is no trace of ornament about him. The side figures are undoubtedly attendants, and differ materially from that of Buddha; their clothing does not reach to the khee, and they have a profusion of chains and ornaments. The hair in one is loose over the neck, in the other covered with an ornamental pointed cap, and they carry a Chowree and fruit in one hand; they are, besides, inferior in size. The right-hand one, besides the

Mughut, which is almost Hindoo in character, has two necklaces, a profusion of chains in the position of the Janwee, and a rich girdle and bracelets ; one hand holds the Chowree, the other rests on the thigh over a knot of the Cummerbund, which passes across the thigh and falls in the shade of the left leg, which is advanced.

The left figure is smaller, and holds, instead of the Chowree, a bunch of fruit,—a Seetaphul or Sureepha,—has bangles and a necklace, but no other ornament, and the hair hangs in ringlets over the shoulders ; the waistcloth passes from behind over the left forearm.

The tableau on the left side is similar, each statue resembling its opposite with the exceptions stated, viz. being a little shorter and looking towards the Daghab. Both seem to portray a Buddhisutwa exhorting, the idea most probably which was meant to be conveyed to those entering or departing from the object of worship (the Daghab), which, contrary to custom, is not in a Chaitya or temple, but in a Vihar.

The figures flanking the doorway of the Daghab chamber stand in vaulted niches, and differ from the others in many respects. They appear to be Buddhisutwas also, and while they have the ornaments of attendants, they have no emblem of servitude, as Chowrics ; on the contrary, one has the "lambent flame of sanctity" expanded behind his head. This is the right-hand figure, and, save in the head-dress, is without ornament. The palm of the right hand is extended, and the cap, which is elaborate, has a seated Buddh surmounting it. The ends of his locks fall on his shoulders, and he stands on an expanded lotus 8½ feet high, and is clothed from the waist only, the dress being gathered behind as Hindoos wear it in the present day. The left figure of the same size would resemble an attendant, but the attitude is not servile or that of a warder, and the open disk or glory is behind the cap, has a seated Buddh in it also. The ornaments, which are in profusion, are handsomely wrought, and the cloth is opened out and spread over both limbs ; the right arm is broken, the left on the thigh ; the attitude is that of attention.

The peculiarity of this Vihar consists in the combination of the Daghab worship with a monastic residence. In most Vihars the figure of Buddha is either the sole object, or it is associated with the Daghab, being carved on its surface ; but at Bâgh the Daghab is evidently the emblem and Buddha subordinate everywhere, and figures of him only met with at the approach to the Daghab.

In plan, the peculiarities are central, supporting pillars, which are not very usual, but indispensable here from the nature of the rock, and a

recess and porch exterior to the verandah pillars, which had the effect of lengthening the frontage and showing it to more advantage.

Cave No. 2 is evidently a monastic dwelling, and has never been meant for any other purpose, having neither Daglob or figures of Buddh anywhere. It has fourteen cells arranged in a peculiar manner. The general plan is a central space with the remains of sixteen pillars without aisles ; the cells are excavated in the rear and sides.

On the left, four cells lead from a passage which runs round a larger and central one, and gives the idea of being intended either for particular sects or for a superior and pupils, as if supervision was required to be exercised, for a degree of superiority is evidently admitted in the arrangement.

The Cave is apparently an appendage to the preceding Vihar, and from its design must have been excavated either for novitiates (Pattijana),—those of the first grade (vide Mahavanso, chapter xvii.), who had not attained sanctification, or a sufficient degree of it to entitle them to cells in the Vihar,—or else for the accommodation of some particular or higher class of the priesthood. The probability of the latter consists in the finish that has been given to the ceilings of the cells and frontage of the Cave, though the traces of these are only visible in the present day. Whichever may be the solution, the Cave is unlike any other known.

It is not connected directly with any other, but is not far distant from the first, in fact only a few paces round the projecting shoulder of the hill. There is a slight ascent and descent to it, indicating that a portion of the hill has fallen in.

The front of the Cave has not had a verandah, and exhibits decoration in the rock which must have been external, the surface is smoothly chiselled (not plastered), and a row of tigers' heads, excessively well executed, is cut in relief between the usual arched emblem of Buddhist caves. Above these is a course of pointed merlins, more like in miniature the arched parapets of Indian forts, or heraldic Urdee lines.

The Cave itself is a parallelogram 60 feet \times 40 and 5 feet high ; it is quite plain, but has been roughly plastered. There have been six octagonal pillars for the support of the roof in quadruple row with corresponding pilasters ; two only remain entire.

The right side is occupied by four cells of the ordinary size (9 feet square) ; on the left is the arrangement referred to. Two small pillars 8 feet high form the entrance to a verandah. In the centre of this is rather a large isolated chamber 11 feet square, on either side

of which runs a passage with doors opening from it with two small cells, making a series of five in one compartment. The same order occurs a little further on in continuation, and this causes one side of the Cave to extend laterally beyond the proper front or entrance.

The ceilings of the passage have all been decorated with paintings shaded in black and white. In the verandah the mosaic patterns prevail, and frets with handsome scrolls; in the large cell a circle almost obliterated, in the angle left by which some chaste figures are well delineated as it were in the clouds.

At the extremity opposite to the entrance of this Cave are three doorways unfinished, the centre large and wide, the side ones smaller. They lead into an apartment 50 feet long by 56 broad, with four rooms of broad, square, rough unfinished pillars, evidently in a preparatory stage. It would appear as if this was an after conception, and the work of a succeeding age, for the rest of the Caves has evidently been complete, as much as there was any occasion for at the time. The united depth of these excavations in the hill is 126 feet, not reckoning the extended range at the side. They have suffered very much from the decomposition of the rock, the sandstone being coarse and loose, with no binding element in it.

Cave No. 3.—As the hill exists at present this Cave is several hundred yards distant from the foregoing, and, judging from the lowness of the scarp and its gradual slope, was never otherwise,—I mean, that no intervening cave existed. There is a path across to it through the brushwood, but the general, and, I fancy, the proper approach is from below and in front, though it is also blocked up with fallen rock and overgrown with wood, which deprives this beautiful Cave of even the remnant of its once splendid architectural front.

It is the largest Cave of the series, 94 feet square, and is remarkable in many respects; it is better lit, the pillars are more elegantly proportioned, and the paintings are superior, more elaborate, and more diversified.

The object of worship is the Daglob in its proper chamber, but without a vestibule; the figures of Buddh are consequently, I presume, painted colossal on the sides of the pillars nearest to it.

To add to the peculiarities there has evidently been a dome in the centre of the hall, and originally constructed too, for the light, medial supporting pillars, though on the same foundation, are four feet higher than those in the colonnade, and are surmounted and connected by a circular frieze or screen (a segment of which remains) several feet above the heads of the pillars, and on a level with the upper edges of this frieze are

the tops of other four square constructed pillars inside the former (altogether 8 feet above those of the hall) ; on these the dome has rested. The inference so far is justifiable.

Connected with this Cave (in one unbroken front, which originally was covered with paintings uninterruptedly) is the Shala or school-room, 94 feet in length, with (at each extremity) corresponding verandah cells. Independent of these and the continuity of the paintings, the soffit of the verandah indicates that these two caves, each upwards of 90 feet long (exclusive of the space marking the partition wall), were included in one splendid colonnade 220 feet in extreme length, and connected by twenty octagonal pillars 14 feet in height. Such magnificence is unrivalled and unequalled in any known Vihar ; a pilaster at each end and one pillar at the south are all that remain of this superb façade.

The first object noticed in the present approach to the Cave at its extremity is a colossal figure of Buddh, cut in relief in the face of the rock a few yards from the end of the verandah ; it is in an arched niche about 13 feet high, in the position of Wiswakarma in connection with the Daghob at Ellora, i. e. on a bench, with the left elbow on the left knee. The left arm has an ornament or Bajoola on it. The right arm is worn away. There is an open Makara's mouth behind his neck, and portions of a riband are seen on the shoulders ; above the head of the figure are remains of a Daghob, with a triple umbrella and two flying images at the side of it.

A few yards further on there is a little recess corresponding exactly to those in the first Cave, and the arrangement would appear to be precisely the same, viz. first a clear landing-place with a recess at each extremity, and over them figures of Buddh in a particular attitude, then the colonnade of the verandah proper, embracing in this instance two caves. At each end of the verandah a cell or side chapel, and then the principal front of the Cave, with its doors, windows, paintings, &c. The landing-place is here flanked at the north end by the colossal figure described ; at the south by five erect figures, not quite so large, and too much defaced to be more than traced.

In the exterior recesses are two figures of Buddh seated close together on a bench, the hooded snake over the right one. The walls are painted with eight rows of diminutive Buddhs, within pointed canopies ; over these, within an archway, are the remains of another seated figure of Buddh, having the Chakra, or praying wheel, beneath him between two antelopes' heads, and flying garland bearers above. This recess borders on the pilaster, which is connected with the colonnade of the

verandah. It is more handsome and rich than that at the opposite end, where a pilaster and one pillar remain standing, and it is just possible that those opposite the Vihar were more ornamented than those of the schoolroom, which are plain octagons (plastered) on a plinth of the same, and 11 feet high to the architrave. This and the excavation of the roof above it give 14 feet as the height of the verandah through its length. From the portions of it which have not fallen in, the roof would appear to have been painted in fret patterns. It is 10 feet wide and 220 feet in length, the intercolumnniation 6 feet, and the diameter of the pillars $3\frac{1}{2}$; at this calculation, and allowing 18 inches to each pillar for the mouldings for the pedestals of the columns, there must have been twenty pillars at least in the façade, a magnificence which has few (indeed, I am aware of no) parallels in any series of Buddhistical caves in Western India.

The above length is unbroken, and made up of the fronts of two caves 94 and 90 feet long, each with a partition or interspace of 36 feet internally. It has been plastered and painted continuously through its whole length in double rows, one above the other; portions of the upper only remain, and even these are scribbled over with names, &c. As the paintings require separate description, it may be more convenient to return to them hereafter.

The internal measurement of this Cave is 94 feet square with twenty-eight pillars; the aisle is 12 feet broad, and the number of cells twenty-four; one, as is customary, opposite the intercolumnniation and at the end of each aisle, and six in rear, in addition to the verandah chapels. These cells are 9 feet square, with a recess and hole for pegs. There is no vestibule, however, and the Daghab chamber is small, approached, as usual, by a high door $11\frac{1}{2}$ feet by 7. The Daghab itself is diminutive and plain for the size and finish of the Cave, which strengthens the idea of there having been a larger and principal one under the dome. This latter would not be at all out of place, it being the original plan of the Ceylon Vihars, according to the Mahavanso, and also the custom of the Nepaul Buddhists, a later and less orthodox sect. The pillars of this Cave are much higher and in better proportion than in the first, being 11 feet high by $3\frac{1}{2}$ feet in diameter. They are subdivided less massively, changing from the square to octagons and polygons, and returning to the octagonal form again up to the abacus. The architraves are half a diameter long, and the intercolumnniation 6 feet—nearly two diameters. The sandstone has been too soft and unfitted for sculpture, its place has consequently been supplied with the kindred science—painting—everywhere, except in the brackets, which, near

the chief door and there only, are carved with figures. On the outer face, figures of lions and tigers ridden by Buddhisutwas, and on the inner, elephants in different attitudes similarly mounted. This is confined to the front row of pillars at the entrances to the Cave and the corresponding pilasters, on one of which is a true Nandi, undoubtedly original and coeval with the Cave. Except at Sanchi and Nassick (the latter of which I shall prove is a copy from Sanchi), I do not remember to have seen it so conspicuously associated with Buddhistical excavations,—certainly not in those of the latest date.

This Vihar derives its light from five apertures, viz. one large door in the centre flanked by two windows, and these by two doors. The last are opposite the side-aisles. The chief door is excessively handsome and well finished, but the rest are scarcely less so. It is 15 feet high, with five pilasters, and 8 feet broad, retiring into 9 feet by 6. The cornice of the door is ornamented with a row of nine Buddhist figures in different positions, and a miniature Daglob at each end. The frieze has a course of heads of Buddh, and the architrav a scroll of roses tournante which pass down the inner pilasters. The consoles are charged with a small female figure having one hand, resting on an infant's head, both standing within an open Makara's mouth; the pilaster underneath being worked in elegant scrolls.

The other doors have much the same ornamentation, and in their general proportions are architecturally correct, their height being double their width. The windows are nearly square, and have on the inside holes for the sockets of wooden closings, and also for a bar to fasten and shut them.

The rear row of pillars in this Cave are plain octagons, the inner faces of them near the Daglob have figures of Buddh painted on them, with the glory or halo round his head; he is here seated cross-legged and quiescent.

All the pillars of this Cave, as well as the ceilings and walls, have been plastered and stuccoed with figures and scrolls in mosaic pattern, and string courses of different kinds, divided into compartments containing flowers, fruit, leaves of trees, animals, and birds interspersed and intersected by borders of various patterns; every spot, in fact, is covered with endless devices.

Above the doors of the cells, all round the Cave, is a handsome scroll 3 feet deep,—I fancy, that which struck Lieutenant Dangerfield. It is best seen on the left wall. It, as well as the rest, is executed in distemper and shaded in black and white merely, not so fine and broad as chiaroscuro, but still evidencing a high degree of perspective

and of art, which, it may be presumed, was of foreign origin, as little trace of it remains among the present races of India.

The central enclosure, or hall proper, of this Cave, is that which characterises it so strongly. It had evidently a dome or centring, which is demonstrated, as much from the outline of the fallen fragments, which lie in a circular form, as from the increasing height of the two sets of pillars which have supported it, as already stated.

The pillars are twelve in number, eight outer and four more central; the former disposed octagonally in pairs,—something akin to the plan of modern Jain temples,—opposite to the third and fourth row, each way of the hall colonnade, and at a distance across of $33\frac{1}{2}$ feet. They rise nearly 4 feet *above* those in the hall, are round, 12 feet in circumference, and are exquisitely carved from top to bottom, differing completely from all the rest, and resembling somewhat those in No. 2 Cave Adjunta, but richer. Above them is a circular frieze 4 feet in height, containing three rows of Buddhists' busts within the emblem, the chief of which encloses a pair, half turned towards each other; the upper and lower rows are faces merely, with the hair made up resembling wigs; the middle one contains entire figures seated cross-legged, the hands resting on the soles of the feet.

On a level with the upper ledge of this frieze, *i. e.* nearly 8 feet above the hall pillars and 4 feet above the last described, are four square constructed pillars, built of cut stone, $5\frac{1}{2}$ feet diameter and 22 feet high, as well as could be measured from the fallen *débris*. They are within the octagon produced by the round pillars, and but 28 feet apart, but the space embraced by the twelve conjointly, having a diameter of $33\frac{1}{2}$ feet, would afford a magnificent dome of 100 feet in circumference, the contents of which it is impossible to conjecture unless it were a Daglob. These constructed pillars are curious and remarkable. They are built of squared sandstone $5\frac{1}{2}$ inches thick and $1\frac{1}{2}$ foot long, without cement, and could scarcely have formed a part of the original design, if they would have been cut from one entire block like the rest, most probably, during the period of excavation, the roof threatened to give way, making their erection necessary. Neither explanation would, however, invalidate the idea of a central dome, as the round pillars are 4 feet above those in the hall, have portions of a circular frieze running around, and connecting them, and are outrached by the constructed pillars, which are 4 feet higher still, making the height of the base of the dome 22 feet, while the height of the roof of the aisle is only 14 feet. It is a remarkable anomaly in Cave

architecture, and doubtless was meant for either a Daglob or image of Buddh, as the usual relic here is insignificant, and out of all keeping with the finish and magnificence of the Cave. Altogether, the external decoration is quite worthy of the splendour which might be expected when a dome of 100 feet is met and a colonnade 220 feet long; and all combine to place it in the first rank of known Vihars. Before describing the paintings on the conjoint front of this and the next Cave it may be as well to give the particulars of the latter, or Cave No. 4.

Though exteriorly within the same continuous front, it is separated interiorly from the last by a partition wall 36 feet thick. It is in shape a parallelogram 94×44 , has neither aisles, cells, Daglob, nor image, and is perfectly plain and without ornament, though it has been plastered.

There are eight pillars lengthways, 12 feet from the walls in a double row and 12 feet apart; their proportions 11 feet high and $3\frac{1}{2}$ feet in diameter—the nearest approach to any recognised principle. They are very peculiar, and give more the idea of being derivations from Greek models than any I have ever met.

The shaft is round, smooth, and unornamented throughout, springs from the floor, and has no plinth or pedestal, and is uninterrupted to the Cavetto cornice, except by a wide astragal, which would have been a torus if properly placed, and which, from its high position, half a foot from the summit, gives it a sort of hypotra-chelion. The Cave is lighted by one large door and four windows, two on either side, 6 feet square, cut through a very thick wall. It has unquestionably been a Shala, used either as a refectory or schoolroom, or perhaps both, and is the most perfect one I know, for the Dehrwara at Ellora is a combination of a Vihar as well.

At the extremity of the verandah there is a cell corresponding to one at the north end, and a pillar and pilaster of the colonnade already alluded to. Inside, at the south end, is a large door 9 feet by 8, which leads into a passage 18×13 feet, at the end of which a similar door leading into Cave No. 5.

This is evidently a dwelling, and in this respect so far resembles No. 2 that it is attendant and attached to the Vihar. It is 40 feet square, and has no verandah; the doors and windows (two), which are of small size, opening out directly into the air. It had six pillars in two rows, of which the capitals and pilasters alone remain to indicate their position and existence. There are five cells in it, three in rear, and two on the farthest side and opposite to the entrance of the schoolroom; they are larger than usual, probably designed for Arhans or instructors. A rough ground-red plaster has covered the walls.

It is between the outer extremity of the verandah of Cave No. 4 and the north window of this Cave that the four figures are carved on the hill, in the space, in fact, corresponding to the passage leading between the schoolroom and it and No. 6, which can scarcely be designated a Cave, for it is a solitary cell without an adjunct of any kind. About twenty yards further on is Cave No. 7, a Vihar, a fac-simile in arrangement, size, and every essential of No. 1. It is 86 feet square, a 20-pillar and 20-celed Cave, but it is so dilapidated and blocked up with fallen roof and pillars that the aisle alone is traversable.

There have been one principal and four small plain doors, and there is a vestibule to the Daghab chamber, but without figures.

The fallen pillars have been plastered and painted as in the large Vihar, but not so carefully or in such variety of colour and shade. It was, however, decidedly finished and complete at one time, though now so much destroyed. Being infested with bears, and occasionally a tiger's residence, it is not very easy or safe to explore it; fortunately from possessing so many points of similarity to No. 1, and nothing novel about it, there is not a necessity for dwelling on it.

From the extreme corner cell of the right side a small intervening cell leads into No. 8, of which only five cells remain, and are quite exposed owing to the hill having fallen in *en masse* close to them. The hill terminates within a very few paces from the extremity of the last cell of this Cave; and the excavators, having small space to work or to carry out any extensive plan, have therefore built up a part of the front with cut stone, and also the backs of the cells of the last Cave when they came close on them.

The remains of this Cave indicate that it also must have been a 20-pillar Vihar; there are three cells in rear on each side of the small Daghab as in caves of that dimension, and also the pilasters of a double row of pillars with two cells between each. Every other part has fallen in, including the roof, and you have to descend considerably to see even this much; the length measured outside by stepping was about 80 feet.

This concludes the series in this direction, but about a quarter of a mile to the north of the first Cave is a large Griha making Cave No. 9, which I came upon accidentally. It is high up in the hill, quite isolated, and has two small pillars opening into a single chamber.

About a mile and half nearer the town of Bâgh, on the banks of the same river, and not far from the Griha of an old Vishnavite temple (remarkable for nothing but a well-carved figure of Vishnu on Shesnaga,

with his Gana and Luximee springing from his navel), I discovered the frontage of another Cave, No. 10.

A door and four windows only exist to trace them by, and a space of 10 feet in their front, the rest being blocked up with earth and rock. In all likelihood they were (if ever completed) a repetition of the more finished series ; they could never have been lofty, as the hill or bank is very low comparatively in this spot, and I incline to think that this was found to be the case, and that they were forsaken and the attempt abandoned.

The paintings at the Bâgh Caves, at least the historical and pictorial part, beyond the mere embellishments of pillars, occupy the entire front of the great Vihâr and Shala, which (as before remarked) are included in one, and measure 220 feet in length. At one time the whole front of this has been covered with paintings about the natural height, in a double row, one set above the other, and the surface extent of the work thus elaborately depicted must have been at least 3,000 feet. The design is no less varied ; but unfortunately very little remains to elucidate the subjects, as the paintings are very much defaced and scribbled over, and the lower row, independent of being inaccessible from the fallen roof, is almost entirely worn off.

They have been divided into compartments separated by stems of plantains and gateways, and seem to incline to and originate from given centres, which are in some places figures of Buddh seated in an arbor. In others, relics, as his garment, gourd, &c. hung under plantain trees in a garden ; and I infer, from the broken detached patches still existing, that either the consecration of these was meant to be re-presented, or the chief acts of Buddh's life, which were embodied in and formed the substance of the Buddhistical doctrines, as on the gateways at Sanchi, only that, being several centuries later, they evidenced a different state of manner, habits, and society.

The paintings seem to me to have been executed in what we know as distemper, not al fresco, for there is by far too much finish, shading, and detail to be consistent with the rapid execution which paintings on a wet surface renders imperative, and from examination of broken portions they seem to have been done subsequent to the final smoothing of the surface. The perpendicularity of the wall does not appear to have been much attended to in the original and underground chiselling, for the rough plaster is in places several inches thick, in others quite superficial, but over both is an even and finer finish of lime.

The most distinct tableau commences over the southernmost and last doorway of the second Vihâr, and extends uninterruptedly over the

partition between it and the next; they were very indistinct until brought out with varnish.

The colours are excessively vivid, with marked contrasts in blue, red, and yellow, amounting almost to the polychrome paintings of the early Greeks, from whom it is possible they were derived; a dark green seems to be the ground generally.

Immediately over the door, from which the best-defined commences, are four seated figures, of a very dark copper colour, the darkest of any in the series. They half face one another in pairs, and are seated cross-legged on blue and white cushions. They are evidently either expounding a doctrine or discussing some point with uplifted hands; the others may be either disciples or listeners. Those on the right have caps on; one square, like those worn by Sindians in the present day; the other coronet-shaped; a child is at their feet. All are profusely adorned with armlets, mankas, the sacred necklace, beads, &c.

The other pair are less rich in ornaments, and one wears the hair plain. They have white and green striped Dhotees, and the lips, eyes, soles of the feet, and palms of the hands are shaded a light slate colour, with very good effect. A sort of balcony separates those on the right from two female figures, one of whom is weeping or resting her head on her left hand in grief; beyond these the paintings are lost in that direction. To the south and left are a group of five seen to the waists; they are also men but differently clothed, having a cloth over the left shoulder, leaving the right arm bare. They are in the attitude of running or hastening to something in advance, the intention being shown by the open extended palms, and by the eagerness displayed in the expression of the eyes and mouth. They are very fair, and the arms, hands, and figures well shaded and relieved; the hair is cut close, and, like all the male figures, no head covering is worn. Below these are five female heads, the figures being destroyed below the bust. One is playing a sitar (very like a modern guitar in shape); the other four of these seem attendants on the fifth or player, who has a head-dress and flowers worn in her hair. The others have their hair in the general fashion of the time, viz. brushed back off the forehead and tied in a knot or ball behind, a piece of ribbon or wreath keeping it together, and being sometimes interwoven with it, reminding one precisely of the women of the Carnatic and Southern India of the present day. In addition to this the women generally have one or two necklaces of pearls or white beads, with turquoise intervening, bracelets and armlets of the same, and

large circular earrings. Their clothing is a pyjama of striped cloth, and when any garment is worn above, it is close fitting, covering the breasts to the neck, and reaching to the middle of the arm.

Dressed and ornamented in this way are two groups of singers and dancers, who are women, one consisting of seven, the other of six figures; each set is dancing around, apparently, a *male* figure clothed in a spotted garment, with his hair in curls over his shoulders, and bound behind with blue and white ribbon. Some of the women are naked to the hips. Each group is tastefully arranged. Some are playing cymbals, others beating time, and one in each group singing. They are painted a light copper colour, the outlines of a darker shade, and the attitudes true; the eyes, mouth, nostrils, &c. of a light green tint, not unbecoming in a drawing; the colours of the clothing are rich and in deep green and yellow stripes.

Separating this from the next group is the coping of a wall angularly placed, and the succeeding tableau consists of thirteen horses with their riders. The animals are all of fanciful colours, crowded together and turning in various positions, but all maintaining the general direction of the cavalcade which is proceeding northward. There is one person only of rank, indicated by a white umbrella over his head, and by being seated on a white horse, which colour appears to have been thus early, as it is still, considered an emblem of superiority with Budhists. The distinctive mark in one horse is a blue throat tuft, and plume.

The animals are spiritedly painted, and their trappings in those days seem to have been light and not profuse; the reins are fine, and the bits scarcely perceptible, but precisely the same character of breasts and flank ornaments as are used by the natives of Upper and Western India at the present time; the saddles are exactly the native khogirs of this century.

The men are remarkable for being uncovered and without beards, their hair done up much like women's; two of them have it in curls, like those around whom the women are dancing in the preceding piece, but here no distinction appears to attach to it. Their dresses fit up to the throat, and are plain blue and white, or in spots and chequered; One carries a bow, and with this exception they are unarmed. As horsemen they sit easily, and hold their reins indifferently in either hand, chiefly in the right; all but two or three are looking forward.

The next piece consists of six elephants and three horsemen entering a castellated portal, which divides this from the preceding. The lower elephant in advance is driven by a superior, holding an open lotus

flower in his hand ; behind him sits an attendant holding an umbrella over him. This elephant, and two others containing women, are the only ones which have jhules on ; behind the former are two of the horsemen, one remarkable for having a turban, *the only one covered in the whole series*. The other elephants are jostling and crushing together through the passage, moving along with their trunks curled, and very faithfully depicted,—their tusks tipped with blue, the favourite colour. One old tusker in the middle (taller and larger than the others) has a white trunk, ears, and forehead, most likely the effect of scrubbing, for his body, and what is seen of his back, is of the natural colour. The Mahouts have the ordinary spuds, and the riders of two carry banners. The two hindmost elephants, though driven by men, carry each three women, the two first of whom ride astride, the third on her knees, holding on vigorously by the waist of her antecedent. They wear a close Dhotee, and are otherwise similar to the previous set. The piece terminates with a small building closed by a diminutive door in front. The gables represent the emblem so frequent in caves, of which it is apparently a receptacle.

The next is a peculiar and interesting group, facing exactly the contrary direction, and consisting of four elephants and three horses, which seem to have arrived at their destination. The elephants are at rest, and the Mahouts quietly reposing, their heads on their arms crossed on the crown of the elephants' heads, which animals are looking steadfastly to their front, as are the horses ; one of the former carries a checked garment in his trunk. There are two avant footmen with swords and spears. Like the rest, they have their attention fixed on the substance in the compartment in advance, which commences with the famous Amb,bo or mango tree, under which are two small frames or stands containing some drinking vessels and a gourd. Close to these a piece of cloth with blue ends is suspended from a branch, and beside it is a Chakru or praying wheel.

Further on under the shade of a plantain tree is a figure of Buddh, seated cross-legged and clothed, holding the thumb of his right hand in his left, and beside him a disciple listening to the doctrine he is expounding. He differs from Buddhist figures in general in being *without* curly hair, and in this respect resembles the other figures met with. A door breaks the further continuation of figures in this direction, and beyond it the surface of the wall is entirely broken up.

To return to the paintings in the opposite or north direction. They are now in such fragmental portions that it was found impossible to take a connected sketch, and all between the first and central doors are

utterly defaced. The best remnants are near the extreme north door, and even they are not distinct, except a few figures here and there, which are much smaller, though some few are of full length but in miniature. Similar to the other pieces, it has been divided into an upper and lower row, the feet of one resting almost on the heads of the other. The aspect of the representation is contrary to the former, viz. southward, towards the remains of a colossal figure of Buddh, the outlines of which can be traced indistinctly sitting in a garden between the first window and chief door. The commencement of the upper row resembles the healing of the sick : one lean man is sitting and another lying down, their limbs emaciated, while a third seems to be carried before a fourth figure, who appears to be advising them.

Two females next occur in a mourning attitude, preceded by a child in glee ; then four dancing figures, and another child running, but looking backwards ;—this borders on the figure of Buddh referred to.

The lower row is excessively indistinct, the heads only being traceable satisfactorily ; none can be counted : there is one, however, a female with a child at her feet, evidently praying to the figure of Buddh above described. Among the foliage, flowers, &c. surrounding Buddh, one or two contemplative heads are also seen.

In addition to the importance attached to every memorial of antiquity generally, those just described would appear to claim especial attention ; ancient Avanti (in which Malwa was included) being inferior to neither Gaya, Ayudhia, Sahrashtra, or Maharashtra as a seat of Buddhism, even previous to the conversion to its tenets of the imperial Asoka, the great captain of that persuasion ; for it is indisputable that the doctrines of Buddhism obtained ascendancy centuries prior to the Christian era in Central India. The Mahavanso (of Tournour), chapter xiv. states that six thousand priests, all sanctified characters, from "Avanti," attended at the Walukarama Vihar at Vaisāñī, and took part in discussing the first heresy, which was put down in the reign of *Kalasoko*, whose era was five centuries b. c., and a century after Buddha's death, which took place 543 b. c. By Central India I do not mean the Aryabhumi of Manu, nor the wide circle described by Fa Hian, including Oude, Benares, Kanduj, as well as Avanti, nor M. Remusat's boundary, scarcely less extensive, but the more modern and conventional tract between 21° and 28° N. lat. and 73° and 80° E. long.

Any one of the Buddhist remains in this distance presents a field sufficiently extensive for a vast amount of argument and speculation, and the more difficult task of substantiation.

It is lamentable, however, to think, with such an ample store of tradition and history, that so little in reality exists to lead to the recognition of any locality of note, with the exception of Ujain, and, I believe, Sanchi, a river or two, and a chain of mountains,—monuments of such magnitude and imperishable nature as not to be easily overlooked under any change of power or language. This want of perspicuity in ancient history and geography forces us back upon the only other available sources of information, viz. style of architecture and inscriptions, both of which, unfortunately, in this case are scarcely less reliable.

That any just inferences are derivable from the mere style of Indian architecture, considering its sameness and want of principle, admits, perhaps, less of question than that inscriptions are faultless proofs of the antiquity of particular structures, seeing that the latter are in many instances the handiwork of successive generations, as often almost as of the original architects. It is, however, in no such spirit that I pass the latter over here, but because I repeatedly and diligently searched the Bâgh Caves without finding the remnant of a letter, which is not a little remarkable.

In respect to style, the question naturally occurs,—are we in possession of sufficient information on the actual state of art in India in any given century during Buddhist supremacy, that is, from the fifth century B. C. to the seventh century A. D., to decide with precision? Notwithstanding the confident classing and grouping of caves by some authors, I venture to reply in the negative. Perhaps Dr. Stevenson, by his recent translations of the Keneri, Carli, and Nassick Cave Inscriptions, thus according positive data to these excavations, has done more to serve the cause of chronology, to the discarding of argument, than has been effected by conjectural writings for the past twenty years; for it must be admitted that the gradations of Indian architecture, if it can be so called, are so ill-defined (within at least two centuries) as to admit of very imperfect classification, and the diversity on the whole is so little, that the last and first (within given bounds) scarcely differ, for critical purposes at least.

The only author who has pronounced a decided opinion on the age of the Bâgh Caves is Mr. Ferguson, and he (evidently from Captain Dangerfield's description, and without assigning any further reason), places them between the sixth and tenth centuries A. D.—an appreciable interval of four hundred years. Independent of certain peculiarities unknown to Mr. Ferguson, I incline to regard even the earliest of his dates an anachronism, and I would place them a century earlier, for reasons which I

shall give. If Shankar Achárya is not a myth, and the Rajawulle (as quoted by Dr. Wilson, in the Transactions of the Bombay Asiatic Society for the year 1853) and the Jejuri legends are true, the limit to the time and power of the Buddhists ceased with him and Khunderao, *alias* Ramachundra, the ruthless exterminators of that sect, about A. D. 620, after which it will be conceded few caves were excavated by Buddhists. But there must have been a preparatory or antecedent period, during which the Buddhist religion, though flourishing previously side by side with the Brahminical from B. C. 263 to five centuries A. D. (vide Mahavanso, and Dr. Stevenson's translations of Nassick Cave Inscriptions), was stationary and even on the wane, the minds of the people being undermined and worked upon for the subsequent change. According to Huien Thsien (Colonel Sykes' Notes on the Moral and Political State of India), Buddhism, at the time of his visit in the middle of the seventh century, A. D. 640, was on the decline, and Brahminical temples and monasteries then outnumbered them. It is scarcely to be supposed that at such an unsettled period any great works, such as would have occupied years to complete, would have been commenced or undertaken, even though the impulse was given by so zealous a Buddhist and potentate as Siladitya, King of Malwa, whose hands were, in the seventh century (Huien Thsien's period), full of conquest. Apart from this, there is yet no inscriptive authority for caves of such a late period, though probably close analogical grounds for the supposition, while in the two centuries previous great activity seems to have prevailed in this respect. Several caves in Western India, in Nassick, and Maharashtra generally, were excavated A. D. 343, 408, and 428, by the Andra Sovereigns. (Vide Dr. Stevenson, in Bombay Asiatic Society's Transactions, July 1853.)

Ujayeri, or Avanti, about this period, was presided over by a Buddhist prince in nowise inferior in point of opulence or zeal to the Andra King, viz. Chandragupta, under the cognomen of Vicramaditya the Second, and, according to Prinsep's reading of the Sanchi inscriptions, he was most liberal to the Buddhist community there. As, then, both the age and the neighbouring countries, as well as Malwa itself, were remarkable for the exertions making for the spread of the Buddhist religion in the fourth century A. D., the presumption (without any strained construction) is that the Caves were excavated about that period, which their own peculiarities strengthen. The only other prince of known extensive power, favourable to Buddhism, was Siladitya, in the seventh century; and in the impulse and transient revival which his energy and conquest gave to Buddhism, the Caves

might suppositively be placed in his reign, but they would most probably have been corrupted both in worship, and by *Brahminical infusion of style and ornaments.*

On the contrary, there is, first, no image-worship anywhere at Bágħ, and though, as early as the third century B. C., "an image of Buddha was produced by a Thero, gifted with thirty attributes of bounty and eighty charms of perfection, surrounded by the halo of glory and surmounted by the lambent flame of sanctity,"* image-worship is acknowledged by all authorities to be a corruption of later date, and, Dr. Stevenson asserts, did not occur in Keneri until the commencement of the *fifth century A. D.* At Bágħ the worship is of the primitive character, enforced originally by Buddhists, viz. that of the Dagħob. An approach to the same, it is true, occurs at Nassick, in Cave No. 6 of Dr. Wilson's Antiquities of Western India, and No. 1 of Dr. Stevenson's; also at Junir and the newly-discovered Caves of Kuda and Wai, but it is incidental merely in these; whereas at Bágħ it is the sole object in every Vihar and under all circumstances, the Dagħob being not in alto-relievo *on the wall*, but in a chamber unconnected with a figure of Buddh in any way; and the same (as I have elsewhere stated) is found at Dumnar and Koolvee.

In Caves, especially Vihars, and also in Chaityas of recent origin, there is, in contradistinction to this, generally a figure of Buddh carved in front, and on the Dagħob or on the vestibule; but at Bágħ there is nowhere a figure of Buddh that is not subordinate to the Dagħob, and they are usually in the antechamber or pillars facing it. In the first Cave the figures on the screen of the sanctuary, with outstretched right palm and the robe held up in his left hand, is, to my idea, a Buddhisutwa, and not the supreme Buddh. They occur at Sanchi in the same relative position, and have the same attendants; also at Keneri and Nassick. The Dwarpals at Bágħ, on each side of the doorway, have also their exact counterparts, in two figures in advance of the Stambha of the north gateway at Sanchi, which must be accepted as emblematic of all that is correct in Buddhism. In the third Cave at Bágħ the figures of Buddh are painted seated and squatting on the pillars *opposite* the Dagħob, and the same in the garden scene; and I believe this to be the true and earliest attitude of Sákya Muni.

2. The strong *historical* similitude in the subject of the paintings on the conjoint Vihar and Convocation Hall to those at Sanchi, the drinking vessel, belt, ablution robe, and figures of Buddh and the

* Turnour's Mahavanso.

amb tree at the close of the procession, with elephants watching, are highly characteristic of the nature and intent of the painting, and seem a realisation of the truth of the description given in the Mahavanso, chap. xviii., of the consecration or erection of a Dagob, which appears to have been closely followed. The peculiarities are, however, a certain southern look about the features and dress of the people, resembling very much the inhabitants of the Carnatic in the present day, saving that the men are without head-dresses (perhaps in virtue of the special duty they are engaged in), and mostly beardless, but the Mahavanso accounts for this in giving it as a sign of ordination, every convert being pressed into initiation and to a withdrawal from the laity.

It may, and has been said, that the gradations of cave architecture are sufficiently distinct to admit of a degree of classification and a characterization of different eras, but it seems to me that this is more applicable to the cultivation or decoration of particular parts, as the enrichment of pillars and the more natural delineation of figures,—to execution, in fact, rather than to any variety of design or proportion.

With very few exceptions Buddhist Vihars, or monasteries, are all on the same plan, varied only on account of the means of the donor or the physical nature of the materials. They are always square, with an open central hall, in *hard* rock, or with pillars to support the roof in softer stone. Some, as at Adjunta and Bâgh, have pillars corresponding to the number of cells, and separating the interspaces into an aisle which runs all round; some have vestibules and side chapels, and others not, but all indicate a general uniformity and consistency of design, the original of which it would be interesting to trace, but which I imagine was *structural*, from the squaring and crossing of the struts and roofs, the addition of windows, with beds behind the jambs of both these and the doors for *bolts* and *shutters*.

As in most points connected with Buddhistic ceremonies, the Mahavanso is here again the guide, and though it is nowhere positively stated that Indian Vihars were constructed edifices, yet, from the description of those erected in Ceylon b. c. 157 (which was converted to Buddhism by Indian missionaries), it may safely be assumed that their ideas were borrowed from the same source.

If I do not mistake, there is a structure to the east of the Sthupa at Sanchi overhanging the cliff, in which a Jain Digambara image is now placed, which was formerly a Vihar: a few cells even now exist to the south of the remains of the Garba Griha.

The general construction of ancient Vihars seems to have been compound, somewhat resembling No. 3 of the Bâgh Caves, namely, a

Vihar with a Daghab in the centre. In the Mahavanso, chap. xxvi. the Daghab is stated to be "encompassed with a Vihar, and the Vihara with a banqueting hall of many stories," the priests being arranged in different floors,—

1. Pattujana, who had not attained sanctification.
2. Those who had acquired a knowledge of Tepataka.
3. Those who had acquired the several degrees of sanctity commencing with Sotopatti.
4. Arhats.

The Nepalese Buddhists (Mr. B. Hodson, page 93, says) adopted a similar plan. "In the *square* in the *midst* of every Vihar is placed a Chaitya, which (he adds) is exclusively dedicated to Adi Buddha the Celestial."

According to the Mahavanso also, the Vihars, which king Asoko, on his conversion, and as proof of his sincerity and exertion for his new faith, caused to be dedicated to each of the discourses of the Buddhist religion (exaggerated though they were to eighty-four thousand), were completed in three years, which would not have applied to the thousandth part of the number, had they been held applicable to *excavations* like the present Caves.

Upham uses the words Vihar and temple indiscriminately,—"The Uphawisica Vihar is termed (page 27) a *building constructed in a particular part of the city*." Again, "King Devanampyatissa constructed the following *temple*, the Kieripalo *Vihar*." The terms must have had synonymous signification, which can only be reconciled with the notion that the structures were on the plan referred to, viz. a Vihar *built* enclosing or surrounding the temple. Rock cells would appear to have been distinct; by Upham they are termed "Meentalah," by Tournour, when in *mountains*, "Mahindagriha," and the commencement of sixty-eight is noted in chap. xvi.

The inference I feel inclined to draw is, that the Vihars of the earlier Buddhists were buildings similar in most respects to the Brahminical *Mâtha* of the present day, such as are to be seen at Ujain and the principal sacred shrines. At Bâgh, I conceive, the Daghab was placed in the Vihar, not so much from the absence of good material to work in, which abounds in the Vindhya Range close by, but from Chaitya temples being *unknown* while the worship was in its primitive state, viz. that of the Daghab.

Of the causes which led to the destruction of the Vihars, while Buddhism was flourishing, or which induced succeeding generations,

during the continuance of the same faith, to adopt the surer or less perishable method of excavations, there is little recorded or even suggestive of surmise.

In respect to architectural pretensions, the former left to the latter very few principles, unless massiveness and decoration can be so called ; for though, from the existence of the base and architrave, their knowledge would seem to have been *derivative*, ponderousness is so much in excess in all their undertakings, and there is so much uniformity throughout, that art with them would appear never to have been put to the very simple experiment of how much breadth and massiveness could be sacrificed, consistent with security to obtain artistic result or effect.

The verification of this imitative trait of the Cave architecture I found at Nassick in caves of the fourth century A. D., the pillars of which were *exact*, though ruder, copies of the Sthamba at Sanchi five centuries prior to them, and Cave No. 3 had, as its doorway, a very rude attempt of the gateway. There were certain alterations, such as two architraves instead of three, the cornices supported by lions ~~not~~ females, but the Chakra, sun, &c. were *depicted* faithfully, also the peculiar balustrade or railing.

At Bâgh, in the pillars of the Convocation Hall, a departure has been made from the routine, indicating that the excavators had found that broad architraves, short pillars, compressed cushion capitals, extensive bases, and close style, were not actually essential for the support of the roof ; but it is questionable whether this was not a design supplied to them from other sources, Bactrian or Greek, for it is not carried further, or met with except in this solitary instance, and evidently was not approved of or appreciated.

The pillars of Indian architecture at this period (for columns they were not) are the most condemnatory evidence of their pretension to art. They have neither cornice nor frieze nor their components, as *Mutules triglyphs*, to form the entablature ; in fact they did not, in this respect, know construction, or the effects of light and shade : but then, it must be admitted, their pillars were, at the most, *internal ornaments*, not external necessities, and sublimity was the last effect aimed at. All their efforts were expended on internal decoration for pillars of 14 feet instead of 40, where variety and ornamentation were more appropriate and pleasing.

The impending amount of their roofs and the nature of their work caused a certain preponderance of mass, which was to be expected from the nature of their materials, and it gave, of necessity, an expression

of mechanical power. The only *motive*, in fact, seemed to be that of support, which was, from lack of science, carried to excess, and the architect then strove, by ornament, to carry off and diminish the effect or defect. So the ponderous architraves were wrought into shapes of animals, the massive columns quartered and subdivided, reeded and fluted, the thickness of the walls broken by receding lintels and mouldings, in order to take off from their solidity and to give a semblance of lightness, which was almost an initiation of a maxim, propounded much later by M. Pugin, of "ornament consisting of the enrichment of the essential construction," except that the latter was here exceeded. Still their uniformity and rectangularity evidence *some* rule of procedure, and some principle; but I question very much if it was *not indigenous*; it certainly was not derived from any school or system *then* or *since* known to the world, the only nation that could have furnished any ideas to them being the Greeks, whose style they have not attempted, and whose period, like that of the Egyptians, was some centuries previous.

The Cave architects were, however, in a measure compelled to study light, and by facing their excavations to the north they obtained sufficient without intensity of heat, or great brightness, for the sun in this latitude is only a few weeks to the north. In respect to apertures, they do not seem to have borne any proportion to the voids. In a space of 80 or 90 feet they had usually five openings; either one ~~central~~ door and four smaller ones, or three doors and two windows. The two lateral doors lit the side aisles and entrances to the cells, the next afforded light to two intercolumniations and to two cells in the rear, while the centre door (always high and lofty) threw the full force of the light on the vestibule and Daghab and centre of the hall, which was left clear for this purpose. That it was sufficiently forcible is proved by their painting, not only the rear walls and pillars, elaborately, but by their having drawings of Buddh on the faces of the pillars *furthest from the light* and fronting the Daghab, which must have been rendered visible.

It would have been gratifying to have identified in the Bâgh monasteries some known establishment of the Buddhist, but the only one ascribed to Avanti in any work that I know of is the Dhakkinigiri Vihâr at Ujayn mentioned in the Mahavanso. This was in existence B. C. 157, for forty thousand (query, forty) from it attended the opening of the great temple at Anaradhapura in Ceylon, with the Thero Dhamarukhito. Ujayn is here meant in its broad signification of "Avanti," as applied to the district or Soubah, not the city, which (as will be seen) was at least one hundred miles from the monastery of Dhakkinigiri.

The Mahavanso says that Mahindo (King Asoka's son), before proceeding to Ceylon, departed from Patna for Dhakkinigiri, to administer the comforts of religion to his mother's relations, where he passed six months. Now Asoka, his father, in a journey to Ujain formerly, had married the daughter of a Setth at Chaitya, which, as I surmised in some remarks on the Koolvee Caves, would probably be found to be the present Stupa at Sanchi. However, a further passage occurs, that Mahindo, having reached Chaityagiri, the capital of his mother, was established on the superb Chaitya Vihar. Mahindo's mother's relations being thus said to be at Dhakkinigiri and her capital Chaityagiri, the identity of the two would seem established. Most probably the former was a name given to a Vihar in connection with the Stupa or Chaitya.

On both occasions, the journeys were commenced from (Patna) Palibathra to Ujain, between which places the Chaitya and Vihar must have been; and if the above surmise of their consonance is correct, it would effectually debar the Bâgh Caves from association with the Dhakkinigiri Vihar, as they are 200 miles to the west of Sanchi, and by so much out of the direct route from Patna to Ujain.

In so far as I know, there is no mention made of any Vihars in Avanti in any other work, and I could not, unfortunately, discover any inscription on the rock or writing on the walls.

The former is not likely to have been executed in such friable rock, and the latter has most probably been detached among the fallen slices of plaster with which the walls have been loaded, to make up for the inaccuracies of the chisel, but it is quite possible a further search may bring some to light.

The dates of the Caves, for the reasons I have given, I should therefore be disposed to place in the fifth century, in the reign of Chandra Gupta, or Vicramaditya the Second.

ART. XIII.—*On the Ultimate Structure of Spongilla, and Additional Notes on the Infusoria.* By H. J. CARTER, Esq., Assistant Surgeon H. C. S., Bombay.

Presented 9th April, 1857.

IN the "Postscript" to my notes on the organisation of Infusoria, dated 10th June last,* it is stated, that apertures exist in the investing membrane of *Spongilla*, and that the particles of carmine taken in through them pass into the substance of the sponge-cells. This was added chiefly to correct an assumption in the body of the paper, that *Spongilla* lived by endosmosis.† I also stated that I should recur to these facts more particularly hereafter; but since that, up to within the last month, I have not had an opportunity of again pursuing the subject. I have during this time, however, succeeded in ascertaining the ultimate structure of *Spongilla*, by following its development from the seed-like body, and this I will now relate.

Those who are acquainted with *Spongilla* are aware, that it is charged towards the base with a number of seed-like bodies of a globular shape, each of which consists of a coriaceous membrane enclosing a number of delicate transparent spherical cells, more or less filled with ovules and granular matter, while an encrustation of gelatinous matter, charged with small spicules peculiar to the species, surrounds the exterior of the coriaceous membrane. It has also been shown that at an early period of development the spherical, which we shall henceforth call "ovi-bearing" cells are polymorphic—identical, but for the ovules, with the ordinary sponge-cell,—and surrounded by a layer of peculiar cells equally polymorphic, which I have conjectured to be the chief agents engaged in constructing the capsule.‡ It is desirable also to remember that

* See Ann. and Mag. Nat. Hist. v. 18, p. 242. The "Postscript" does not appear after my "Notes" in this Journal, because they were printed before I discovered my error.

† This Number, p. 446.

‡ Ann. and Mag. vol. 18, Pl. vi. figs. 41, 42.

there are these two kinds of cells in the composition of the seed-like body, because we shall find by and bye that they appear in corresponding parts of the newly developed *Spongilla*. Lastly, the seed-like body presents a hole, which we shall call the "hilum."

Having thus briefly alluded to the constituent parts of the seed-like body, let us now pursue the development of *Spongilla* from it. This takes place in the following order, viz. 1st—The contents issue through the hilum under the form of a gelatinous mass, in which the ovi-bearing cells and their contents appear to be embedded *entire*. 2nd—The spicules begin to be developed, and with them is formed a delicate pellicle, which not only encloses the new *Spongilla*, but also the seed-like body; to this pellicle we shall give the name of "investing membrane"; this becomes separated by an interval (which we shall designate the "cavity" of the investing membrane) from the gelatinous mass containing the ovi-bearing cells, which we shall term the "parenchyma." 3rd—Apertures are developed in the investing membrane, and a system of afferent and efferent canals in the parenchyma; the afferent canals commencing in many large apertures and afterwards communicating with each other, and the efferent canals commencing in *ramusculi* which end in a single tubular vent. In this period also the spicular structure is formed and arranged. 4th—The ovi-bearing cells ~~are~~ developed into spherical ampullaceous sacs, communicating with the afferent canals; and the afferent and efferent currents are established. We will now follow this more in detail.

FIRST PERIOD.—Three or four days after the seed-like body (which has never been allowed to get dry)* has been placed in clear water, a white substance, like cotton, is seen to have issued from the lower part of it. This, when examined, is found to present a flat, transparent border, so abounding in (indolently contracting) vesicles of different sizes, that it looks like an areolar structure. I wish particularly to call attention to this point, because it resembles the vacuolar state of the protoplasm in the early development of the cell of the Characeæ and probably of vegetable structures generally. The margin of this border is more or less irregular and digitated, from the polymorphic substance of which it is composed; while further in may be seen the ovi-bearing

* For this purpose it is best to place a piece of *Spongilla*, charged with the seed-like bodies, in a basin of water, where it will soon get putrid; but this does not matter; the seed-like bodies still retain their vitality, and will throw out the young *Spongilla* much more quickly than if taken fresh from the living mass. Those which I have used for these experiments belong to *Spongilla alba*, H. J. C., which was taken from the tank a year since.

cells in the denser gelatinous matter, with their ovules already somewhat diminished in size. The spicules have also begun to appear.

SECOND PERIOD.—We may commence with the formation of the spicules, which is so rapid, that they come into view almost simultaneously with the issue of the substance of the seed-like body.

Spicules.—These appear to be formed in sponge-cells of a peculiar kind, one of which is confined to the parenchyma, viz. that which forms the large smooth spicule, and the other to the seed-like bodies and the investing membrane, viz. that which forms the small spiniferous spicule characteristic of the species. Of the former, I can state nothing, except that it appears to be filled with ovules like the ovi-bearing cell, while the latter is characterised by the absence of ovules, a uniform granular composition, and the presence of a nucleus.

At the earliest period that a spicule becomes visible it appears under a hair-like form of immeasurable thinness, and enclosed in a sponge-cell of a spindle-shape, which has assumed this figure to accommodate it. The nucleus of the cell is now seen in its centre, and the spicule about $\frac{1}{100}$ th of an inch in length lying across it. After a few hours the spicule becomes much larger and longer, and the sponge-cell still more extended to retain it within its substance; it also presents a glairy ovate globule in its centre, through which its shaft passes, not in the line of the longitudinal axis but on one side of it, so that the globule looks as if it were appended to it. When, however, the spicule is arrested at this stage of its development and denuded of the sponge-substance, that part which in the sponge-cell appeared to be a glairy, refractive globule, is found to be merely an inflation of the outer wall of the spicule, for the shaft of the spicule, slightly diminished in size, may then plainly be seen to pass through it in the manner before-mentioned, and to present the longitudinal canal in its inside. In this state neither undiluted nitric acid nor a saturated solution of caustic potash produces any change in it, so that it may fairly be assumed to be of the same composition as the rest of the spicule.

By degrees, as the spicule is enlarged, the inflation is also proportionally increased in size, and disappears only when the spicule is fully formed. The normal state of the inflation appears to be single and in the centre of the spicule, but it may be situated on any part of the shaft or present in variable plurality.

In my notes on the organisation of the Infusoria I have stated§ that the spicule grows from a hair-like extension projecting from either side of a glairy globule, which now is found to be nothing but an inflation,

§ P. 118, Annals and Mag., loc. cit.

probably filled with refractive fluid. However, as we see that the spicule grows by layers deposited on the original one, which, therefore, forms the longitudinal canal, and, when it is fully formed, that the inflation is no longer visible, at the same time that the inflated portion is continuous with the outermost layer of the spicule while the latter is growing, it does not seem improbable that the first layer does arise from the linear extension of a globule, and that every succeeding layer is formed in the same way; (hence as there will be more layers in the centre than at the circumference, the spicule assumes a pointed form at each extremity), the inflation subsiding with the extension of each layer, until the final one leaves no inflation at all, and the spicule assumes its ultimate form. The original form of the spicule, therefore, appears to determine its ultimate one, and the spiniferous character of this will therefore depend on the tendency in all the layers to more or less assume this figure, whatever it may be. Whether the spicule is developed throughout by the same sponge-cell, or whether, after it very much exceeds in area any of the sponge-cells, which is always the case with the large spicule, a plurality are engaged in its ultimate development, or whether it continues to grow in the intercellular substance until it has reached its largest size, I am ignorant; but I have ascertained, by a series of observations and measurements, that it does not grow ~~on~~, having become denuded of the sponge-substance.

Again, I am not certain that the inflation, though extremely common, is always concomitant, or even necessary in the formation of the spicule, for many present no trace of it in any stage of their development, from the time they are first visible to that in which they have attained their largest size.

Long before the spicules are formed, however, they are transported from place to place by the sponge-cells individually, and when too large for this, are twisted and turned and grouped together by the general mass to meet the requirements of the case, with as much instinct as that which characterises the arrangement of the bits of stick in an ant-hill; while they appear never to become finally fixed until the substance in which they may be imbedded has altogether lost its vitality.

Investing Membrane.—As the sponge-substance accumulates vertically, the flat transparent border seems to disappear by being raised with the pellicular covering of the *Spongilla* generally, until it presents a considerable angle of elevation at the circumference; while the parenchyma, either by contraction within, or by forcing outwards bundles of its large smooth spicules, here and there separates itself from the

pellicular covering, and thus both the investing membrane and its cavity are formed. The investing membrane now supported in its position by these bundles of spicules, and kept on the stretch by the small spiniferous spicules which are scattered through its substance, presents two objects well worthy of description, viz. the peculiar cell to which I have before alluded, and a number of apertures.

The cells of the investing membrane are characterised by their uniformly granular composition and colourless appearance. They are nucleated, possess the contracting vesicle singly or in plurality, and are spread over the membrane in such numbers, that it seems to be almost entirely composed of them; while they are of such extreme thinness, and drawn out into such long digitated forms, that they present a foliated arrangement not unlike a compressed layer of multifidous leaves, ever moving and changing their shapes. This is, as I have before stated, the same kind of cell as that which forms the cortical layer of the seed-like body at a very early period; and, as will be seen hereafter, is further characterised by not enclosing any carmine when the other cells become charged with it.

The apertures, on the other hand, are circular or elliptical holes in the investing membrane among (in?) these cells. They seldom exceed $\frac{1}{10}$ th of an inch in diameter, have a clean thin margin, which in one part presents a slight tubercular enlargement, and are generally surrounded by some minute colourless granules; while they have the remarkable property of closing or dilating like the pupil of the eye, but generally with extreme tardiness instead of the velocity observed in the latter. The tubercle looks very much like the nucleus of a sponge-cell, and, when the aperture is contracted, the granules may be seen to be enclosed in a circumscribed form, which, together with the presence of one or more contracting vesicles, gives the whole very much the appearance of one of the sponge-cells peculiar to the investing membrane. Through the apertures the particles of food and other substances suspended in the surrounding water are admitted into the cavity of the investing membrane, preparatory to passing into the parenchyma, in the manner which will presently be mentioned.*

Independently of all these structures, together with an innumerable number of minute contracting vesicles, the investing membrane is so

* These are the apertures to which I alluded in the postscript mentioned. Mr. Bowerbank also discovered them about the same time in England, and mentioned the fact at the British Association (*Athenaeum*, 30th August 1858). His paper in the Quart. Jl. Microscop. Science I have not yet seen.

transparent, that every part of its cavity can be seen as clearly as if there were no membrane at all.

PARENCHYMA.—This consists of a mass of gelatinous substance, in which are imbedded the smooth spicules and ovi-bearing cells, and through which pass the afferent and efferent canals.

Ovi-bearing Cells.—The ovi-bearing cells do not burst and allow their contents to become indiscriminately scattered through the gelatinous mass in which they are imbedded, but each becomes developed separately, and entire in the following way, viz. the ovules and granules of the ovi-bearing cell subside into a granular mass by the former losing their defined shape and passing into small mono-ciliated and un-ciliated sponge-cells ; this mass then becomes spread over the interior surface of the ovi-bearing cell, leaving a cavity in the centre, into which the cilia of the mono-ciliated sponge-cells dip and keep up an undulating motion ; meanwhile an aperture becomes developed in one part of the cell which communicates with the adjoining afferent canal, and thus the ovi-bearing cell passes into an ampullaceous, spherical sac. The cilia may be now seen undulating in the interior, and if the *Spongilla* is fed with carmine, this colouring matter will not only be observed to be entirely confined to the ampullaceous sacs, but when the *Spongilla* is torn to pieces and placed under a microscope particles of the carmine will be found both in the interior of the mono-ciliated as well as in that of the un-ciliated sponge-cells ; proving, that of such cells the ampullaceous sac is partly composed.

This sac then must be regarded as the animal of *Spongilla*, as much as the Polype cell is regarded as the animal of the *Polype*, and the whole mass of *Spongilla* as analogous to a Polypidom.

Sometimes an isolated ovi-bearing sponge-cell which has escaped from the general mass may be seen to have undergone the same development by itself in the watch-glass ; but in this case there appears to be no aperture, for particles of carmine brought into contact with it indicate no currents about its exterior, while within the cilia may be undulating as actively and as evidently as if it were *in situ*. Another proof also of the absence of an aperture is, that under this condition the ampullaceous sac encloses the particles of carmine which are in contact with its exterior, after the manner of *Amœba*.

I have stated that the contents of the ovi-bearing cell during development become spread over its inner surface, but at the same time I think it questionable whether this cell becomes revivified, or whether it is not ultimately cast off after a new one has been formed.

In proportion as the ampullaceous sac experiences a want of nourish-

ment after it has been fully developed in the watch-glass, so it gets thin, and, becoming more translucent, not only allows its aperture to be better seen, but presents an indistinct meridional lineation, which, radiating from around the aperture, meets at the opposite pole of the sac, thus giving the former an appearance not unlike the pupil of the eye; but though at one time it is larger and at another smaller, and not unfrequently of an irregular circular form, yet its changes are so gradual, that I have seldom, except when carmine has been added and taken into this sac, been able to see any alteration in its size or form for an hour together. When the aperture is in focus, the opposite point of the sac is invisible.

Afferent Canals.—The afferent canals consist of a number of channels which open by large apertures into the parenchyma from the cavity of the investing membrane, and then, freely anastomosing, form an areolated cavernous structure, throughout which the particles which are admitted into the cavity of the investing membrane subsequently circulate, and are finally received into the ampullaceous sacs which open into them.

Efferent Canals.—The efferent canals, on the other hand, begin by radicles in the interstices of the cavernous structure, among the ampullaceous sponge-cells (with the cavities of which, however, they do not communicate nor with the efferent canals, as will be seen hereafter), and growing into large branches, at length unite in a single tube. This tube extends beyond the periphery of the *Spongilla*, and ends in a mammiliform point, in the centre of which is a single contracted aperture.

Thus we have the structure and composition of the portion of *Spongilla* developed from the seed-like body. Let us now direct our attention to its functions, which are easily elicited by placing a little carmine in the water and watching the particles as they pass through its substance.

No sooner has the carmine reached the exterior of the investing membrane than its particles are rapidly drawn in through its apertures, not voraciously but direct, and, traversing its cavity, or the interval which exists between the investing membrane and parenchyma, in different directions, are thence drawn in through the apertures of the latter, and finally into the ampullaceous sacs, where they remain a quarter of an hour or more, until they are thrown off and find their exit through the efferent system of canals.

During their course, we observe, that on arriving near the ampullaceous sacs, they are rapidly drawn aside and for the most part pass into their cavities; and, seeking for those favourably situated for such

observations, that is, at the circumference of the parenchyma, we not only see that this takes place at one point only, but also, frequently, that at this part of the sac there is the circular aperture mentioned, and that they pass in through this aperture; further, after a certain time, we observe, that the particles of carmine which have accumulated round the inner surface of the sac, are gradually thrown off from its circumference, and, falling into the efferent system of canals, are thus carried away and finally ejected.

It would have been satisfactory to have seen the particles pass in through the aperture* while the latter was uppermost or undermost, and in the focus of the microscope, but this I could never do, perhaps from the rapidity with which they are whirled into the interior; but when the aperture happens to be on one side of the sac, the particles may be seen to pass through it into the interior, and generally to adhere to the first part with which they come into contact, when they are instantly enclosed by the sponge-cell on which they impinge. Again the aperture would not appear to be the only part of the exterior of the ampullaceous sac which is in communication with the afferent canal, but a much larger portion is bathed by the afferent fluid, for particles of carmine may be seen to adhere to the external surface of this sac as well as to be carried into it; and the latter seems to be more the case as the sac ~~is~~ altered from want of nourishment, after having reached its maximum of development under the circumstances mentioned.

If now we clear the watch-glass of all superfluous carmine by dipping it in clean water, and again place it under the microscope, the facts to which I have before alluded will become perfectly evident, viz. that the colouring matter is wholly confined to the ampullaceous sacs, and that the sponge-cells of the investing membrane do not contain a single particle; while, by tearing the *Spongilla* to pieces, it will be found as much in the bodies of the mono-ciliated as in those of the un-ciliated sponge-cells. Thus the component parts of the ampullaceous sac are easily demonstrated. One point, however, remains to be proved, namely, that there is no direct communication between the afferent canals, or the ampullaceous sacs, and the efferent canals. This is easily effected by placing a little carmine in the water and observing the moment of its entry through the apertures of the investing membrane and its exit through the afferent tube, when the interval will be found to

* This aperture corresponds in every respect, except the presence of the tubercle, with the aperture of the investing membrane; but I never could entirely satisfy myself that the latter was not a contracting vesicle, until I saw the particles of carmine pass in through it.

vary; but being seldom less than a quarter of an hour, is quite sufficient to show that there is no direct communication between these cavities; while the mode of enclosing the particles by the small sponge-cells being known to be like that of the *Amœba*, and their having been seen to throw them off at the circumference of the ampullaceous sac, and be immediately carried away by a current passing through the canal into which they are thrown, is still further corroborative of the fact; but indeed it requires no corroboration, for when the sacs are only one layer deep it can be seen.

We have now to consider by what power the particles are drawn into the ampullaceous sacs, and how a constant current through the *Spongilla* is maintained—questions which we can only hope to answer by a study of the organs of *Spongilla* individually, and fortunately, as far as the first enquiry goes, this is much aided by the change which takes place in the new *Spongilla* a few days after it has been developed.

The same difficulty which exists in maintaining life in the Infusoria, viz. the want of proper nourishment, is experienced with respect to the young *Spongilla*, and hence sooner or later it becomes starved; but frequently just before this takes place, the whole community of sponge-cells, more or less, separate, dissolve partnership so to speak, leave their habitation, and issue forth into the watch-glass to seek independent existences respectively for themselves. At this time the ~~ampullaceous~~ sac may be seen entire, but reduced to an actinophorous form, and presenting a single nucleus, while in other instances the community of this sac have separated and its mono-ciliated and un-ciliated sponge-cells are also seen spread about the watch-glass; also groups of much smaller mono-ciliated cells like those called *Uvella* by Ehrenberg; and lastly the characteristic sponge-cell of the investing membrane.

The one, however, which interests us most here, is the mono-ciliated sponge-cell of the ampullaceous sac (that which I once supposed to be the *andro-spore*), and this may be seen attached by a pedicular elongation of its substance to the watch-glass on one side, and with its single cilium undulating on the other. We have it now, then, exactly in the position for ascertaining the direction of the currents of the latter, and these, when a little carmine is added, are found to be towards the body on either side of the cilium, by which the particles of carmine may be seen to be thrown almost point-blank on its surface, and at the same time caught up (by apparently adhering to it, or by a process thrown out by it as in *Actinophrys*, *Sol.*) and rapidly passed into the interior. Hence we may easily conceive the united effort of all the ciliated sponge-cells in the ampullaceous sac being sufficient to produce a

considerable current into its interior, and thus to catch the particles which are passing through the afferent canals.

The other question, viz. that of the afferent and efferent currents, is not so easily solved, but still the mono-ciliated sponge-cell supplies data for at least speculation on that point. I have already shown in my notes on the organisation of the infusoria that the vesicula or contracting vesicle is an excretory organ, and that it discharges itself from the surface in many Infusoria, especially in the naked Rhizopoda, to which the sponge-cell is most intimately allied; and it so happens, that not only do these mono-ciliated sponge-cells present the contracting vesicle in great activity, but also in variable plurality, so that with those of the other sponge-cells lining the cavity of the ampullaceous sac, a continual and rapid discharge of water must be kept up, which, when we remember the character of this organ to discharge itself from the surface, and find that when the ampullaceous sac leaves the parenchyma it becomes nothing more than a large sponge-cell, we have, I think, pretty good reason to infer that these organs discharge their watery contents into the efferent system of canals; and when we consider the powerful organ which the contracting vesicles of all the ampullaceous cells together must form for effecting this function, that it does not seem unreasonable, in connection with the following facts, to conclude that the currents, both afferent and efferent, of the sponge, may be produced in this way.

It might be supposed, from what has been stated respecting the course of the particles of carmine through *Spongilla*, that the afferent and efferent currents never cease as long as it is alive; but such is not the case under some circumstances, for although no difference is appreciable when only a small quantity of carmine has been taken in, yet when there is an abundance in the water and the ampullaceous sacs become apparently filled with it, not only do these sacs one after another seem to close their apertures and refuse admittance to any more, but the whole investing membrane becomes drawn towards the parenchyma, its apertures all become closed, and the tubular vent of the efferent system retracted, and its aperture also closed, so that there is a total cessation of all active motion in the *Spongilla*; and this may continue for more than an hour, when the vent is seen to project itself as gradually as it became contracted, the investing membrane to resume its original position, and the apertures in both to open and admit and emit their currents respectively as before; but this time; the latter brings away the refuse of the carmine which has been and is still being thrown off into the efferent canals. In fact the *Spongilla* having been fed to satiety, appears

thus to shut itself up for a time for the purpose of digestion, and then open to throw off the refuse.

Again, it sometimes happens that one of the large branches of the efferent system bursts and gives rise to an efferent current before the tubular vent resumes its original dimensions and opens its aperture, by which two efferent currents are subsequently established, for the abnormal one does not close when the normal one becomes opened. Hence we have a further indication of pressure on the contents of this system, which will hardly derive explanation from anything but a force exerted by the contracting vesicles in the way mentioned ; the conditions of the fluid in the afferent and efferent canals hardly holding out a sufficient difference in composition or density to account for this by endosmosis.

Thus we find *Spongilla* (for I have ascertained that the same structure exists in the large masses as in the small ones) composed of a number of stomachal sacs imbedded in a gelatinous substance permeated with specules for its support, and an apparatus for bringing to them food, as well as one for conveying away the refuse, while the nutriment which is abstracted by the process of digestion common to Rhizopodous cells, (*ex. gr. Amœba*), no doubt passes through the intercellular gelatinous substance into the general development of the mass ; and if right in comparing the ampullaceous sacs to the stomachal cavities of the simplest Polypes, are we not further justified in drawing a resemblance also between the ciliated sponge-cells and those which line the stomach of *Cordylophora*,* of *Otostoma*,† and many of Ehrenberg's Allotreta ; together with those in the stomach of the *Rotatoria* and *Planaria*,‡ which are evidently biliary organs, also having cilia floating in the cavity which receives the food.

Lastly, it is perfectly evident that each mono-ciliated sponge-cell possesses a large granule, which is of a greenish colour, and that the assemblage of these cells in the interior of the ampullaceous sac produces the assemblage of granules which are seen in it ; also that these granules, when the ampullaceous sac becomes individualised and assumes an actinophorous form, represent "the granules" which I have described as a part of the internal contents of the Rhizopoda. May we not infer from this that these indicate the presence of similar cells in the interior of *Amœba*, &c.? If this should be the case, and that they are homologous with the liver-cells of the *Planaria*, then I shall

* See Prof. Allman in Phil. Trans. 1853, p. 370.

† Ann. and Mag. Nat. Hist. v. 17, p. 117.

‡ *Item*, v. 8, Pl. vii. fig. 92.

have been right in my original conjecture that the "granules" are the homologues of the "spherical cells."*

It is proper to notice here, also, the affinities which *Spongilla* has to the vegetable kingdom. I have already alluded to the resemblance between it and the cell of the Characeæ at an early period, when both are filled with vacuoles; nor is the plurality of the contracting vesicle in the Rhizopoda generally, when matured, a less striking instance of the transition of the vesicula or contracting vesicle in the more animal infusoria into the passive vacuoles of the vegetable protoplasm. The nucleus of the Rhizopoda is typical of that which exists in the vegetable cell. Similar "granules" are also seen in motion at the extremity of the root-cell of *Chara* in the "fixed protoplasm"; and at present no difference can be shown between the molecular protoplasm in each. While as regards the production of starch, that is so common in every specimen of *Spongilla* that is met with, more particularly at the end of the season, that its presence is no novelty whatever. The mode of taking nourishment is different; but I have already stated that when the protoplasm leaves the cell of *Spirogyra*,† and even before its exit, it encloses nutrient matter after the manner of *Amœba*. While for the last year, some plants of *Chara*, which I reared from the nucules and have grown in a glass jar, have only been kept vigorous by dead grass,‡ which every now and then, when the *Chara* begins to grow lighter in colour and meagre in appearance, have, by being thrown into the water, restored it to its former condition.‡ So that the same elements, under different circumstances, are thus made subservient to the same purposes. Hence the sponge-cell appears to be but a naked condition of the vegetable cell, and thus to become the first, or among the first, of animal organisms.

I would here also recur to the forms which the substance of *Spongilla* assumes when, under threatening of starvation, it leaves its habitation; not more to particularise these forms than to show how closely they resemble those of the protoplasm of *Spirogyra*, when, under simi-

* Ann. and Mag. Nat. Hist. v. 18, p. 125.

† See abstract of paper on the "Transformation of the vegetable protoplasm into *Actinophrys*," further on.

‡ In this instance I have noticed that the moment the plants become robust they cease to bear fruit, while when they become impoverished they throw forth nucules. The physiology of which appears to be evident, viz. so long as there is plenty of nourishment to build up more structure for ultimately making more propagative germs, this alone occupies the instinct of the plant; but the moment the nourishment ceases, the instinctive fear of failing in the propagative department causes the plant to turn its attention to preserve itself by forming seeds.

lar circumstances, it also leaves its natural habitation or cell-wall and seeks for food elsewhere. The smallest is that which resembles *Uvella*, Ehr. This consists of a number of minute mono-ciliated flask-shaped cells, which adhere by their pointed extremities respectively to a common centre point, whence the whole assumes a globular form. They are about $\frac{1}{3}$ of an inch in diameter, polymorphic, and present the granule and contracting vesicles like the mono-ciliated sponge-cell of the ampullaceous sac; also enclose particles of food, and, on separating from each other, attach themselves by a prolongation of the body to the watch-glass, so that they are but a miniature type of the ciliated sponge-cell. The latter again, which I have already described, loses its cilium a day or two after it has come out into the watch-glass, and assumes an actinophorous form, becoming at last encapsuled. Previous, however, to losing the cilium, it progresses with the latter in front, and not behind, as when it is set free by tearing up a piece of *Spongilla*. While the ampullaceous sac, when remaining entire, also assumes an actinophorous form, loses all appearance of cilia internally, and encloses food after the manner of *Amœba*. All of which figures are so like those assumed by the protoplasm of *Spirogyra* when it breaks up and undergoes the changes to which I have alluded, that no doubt can be entertained of both organisms being Rhizopoda at this period.

Of the sense of feeling in *Spongilla* I have had no ~~more~~ sensations beyond the instinctive acts to which I have alluded; and that wonderful power of opening an aperture through itself, which the sponge-cell of the investing membrane apparently possesses; but in *Amœba Princeps*, which is a closely allied organism, I once saw the surface contract and become pucker'd several terms successively, on being pinched by a rotatory animalecule (*Diglena*), an experiment which this animalecule performed for me so satisfactorily, that I have no longer any doubt about the matter.

The "swarm-spore" described by M. N. Lieberkühn,* which appears to me to be a ciliated form of the seed-like body and the same as the "gemmula" described by Dr. Grant, I have not yet been able to see; nor have I been able to see his "spermatozoa-like bodies," unless the *Uvella*-form just mentioned be them.

The formation of the seed-like body, however, now that we know the structure of the ampullaceous sacs, seems very intelligible; for we have only to conceive an enlargement of the small sponge-cells lining its interior, with the addition of ovules to them respectively, and the

* Ann. and Mag. of Nat. Hist. v. 17, page 407, 1856.

spicule-bearing sponge-cells of the cortical substance supplying the spicular crust to the exterior, to have a globular capsule thus composed, with a hilum precisely like the seed-like body; a conjecture which seems to derive support from the fact, that in some instances when the *Spongilla* is beginning to experience the want of nourishment, these sacs, small as they are, assume a defined, rigid, spherical form, from their pellicula becoming hardened and encrusted with extremely minute spicules.

*Additional Notes on Fresh-water Infusoria in the Island of
Bombay.*

As the printing of this Number of the Society's Journal is not yet closed, and I have observed several parts in my "Notes"** which require correction, alteration, and further explanation respectively, I take this opportunity of communicating the observations necessary for this purpose, and at the same time of supplying additional matter, which will render them more complete.

Vesicula.—At p. 443 it is stated that the existence of the vesicula "in *Astasia*, *Anisonema* (Duj.), and *Euglena* can only be determined by inference." Since then I have seen the hyaline vesicle, supposed to be the vesicula, empty itself in all three of these organisms, but more particularly in *Euglena viridis*, wherein a description of the process, which is peculiar, will serve for all the rest. It has been already stated, that in *Anisonema* the vesicula seemed to alter in size and shape without completely contracting, which is more or less the case with all this class of animalcules, and appears to arise from the presence of a single sinus in connection with the vesicula, as will be seen by the following description of the mode in which this function is performed.

In *Euglena viridis* the single sinus, which is attached to the side of the vesicula, after having become filled, pours its contents into the latter; the vesicula thus distended, is now pressed upon by the gradual refilling of the sinus, and thus its contents also become evacuated. Hence we never witness that sudden contraction of the vesicula which is so common in other infusoria, at the same time that it often appears double in *Astasia* and *Anisonema* (where it is more evident than in *Euglena* owing to the absence of colouring matter), from both sinus and vesicula being more or less distended together.

The only way in which this process can be well seen is, by getting specimens of *Euglena viridis* which are turning red, filled with ovules

* This Number p. 429.

and about to become capsuled or have been just burst from their capsules. These, which at this time are spherical, if placed in water under a light piece of glass and the water partly abstracted by bibulous paper, will, by the pressure of the glass, assume a compressed circular form, in the centre of which the vesicula and its sinus may be observed in full operation and be deliberately watched for some time, or until the infusorium dies.

Besides having been seen in *Polytoma uvella*, and *Chlamidomonas*, as before mentioned (*loc. cit.*) the vesicula has been seen and described by Mr. G. Busk in *Volvox Globator*,* and having myself also seen it in the *Thecamonadiens*, besides several species of *Euglena*, while it would appear that Cohn has observed it in the swarm-cells of *Conferveæ*, its existence throughout this class of Infusoria seems thus to be established.

At p. 442 it is also stated respecting the vesicula—"in *Euglypha* I have not been able to recognise it"; but since then I have seen it frequently; it is situated in plurality just in front of the nucleus, as in *Euglypha pleurostoma*, H. J. C. (*nov. sp.*).

Ovules.—At p. 449 I have stated, respecting the "ovules" of Infusoria, that "they occur in *Euglypha alveolata*, Duj., congregated round the hyaline capsule of the nucleus, from forty to fifty in number," &c. I have also observed this in another species, viz. the one just mentioned, for which I propose the name *E. pleurostoma*; and the same kind of development described in the "larger variety" of *E. alveolata*, p. 452, as well. *E. pleurostoma* is very like Ehrenberg's *Difflugia Enchelys* and Dujardin's *Trinema acinus*, but not being identical with the figure given of the former, and though often presenting three radiated prolongations of the diaphane like the latter, but by no means constantly, it becomes necessary to give it a name. It is just possible hereafter that all three may be found the same, but even then it would be well to retain the term "*Euglypha*," because *E. pleurostoma* is essentially of this genus, the only differences between it and *E. alveolata* being the lateral position of the mouth and the circular figure of the scales in the former.

At p. 459, under the head of "Impregnation," it is stated that many of the ovules of *Spongilla*, when pressed out from the seed-like body, have a small granule or cell "in different degrees of connection with them, from simple approximation to almost undistinguishable incorporation"; the same is the case with the ovules of *Euglena viridis*.

At p. 459, under the head of "Development of the ovules," it is stated that the same process as that which takes place in the

* Quart. Journal Microscop. Sc. vol. i. p. 35.

development of the ovule of *Spongilla* "appears to take place in the ovules of *Euglena*," and this, to a certain extent, may be really the case ; but as the ultimate forms of the two organisms are different, so there must be a point at which their developmental appearances begin to differ. This, in the ovule of *Euglena viridis*, consists in the evolution of a spiral structure, which, when fully formed, appears to spring out in opposite directions, and thus, with the diaphane, afford that means of vermicular progression which *Euglena* always presents when void of, or with only an injured or imperfect cilium.

I infer this from the following circumstances : first, that in a watch-glass, where a number of the ovules of *Euglena viridis* had been placed for observation, about a hundred small *Euglenæ virides*, closely corresponding in size with the largest ovules, made their appearance, elongating and contracting themselves incessantly for several days without moving far from the place in which they appeared to have been developed (on account of the imperfect state of their cilium), and, being without chlorophyll, presenting exactly the same appearances as fully developed individuals under similar circumstances. Secondly, from the ovules which remained on the sides of the basin from which those in the watch-glass were taken, presenting, after a while, a spiral line on both the flat sides of the compressed ovule, which apparently, from its resiliency, caused these sides to become prominent and obtusely conical ; thus indicating an advance of development in these, as well as in most of those of the watch-glass, which was arrested, probably, from want of proper nourishment.

Now when we consider that the cells of *Euglenæ*, which we have called ovules, do not present any signs of an amyloid composition when treated with iodine, that the existence of the spiral line proves them not to be mere oil-globules, while the cell of *Euglena* ultimately develops a spiral structure in its substance, as I have particularly pointed out in *Ormenula texta*, Duj., and a number of minute *Euglenæ virides* made their appearance among a group of ovules of this organism, carefully set apart in a vessel for development ; there can, I think, be very little doubt but that these cells, which are common in all the family, are in reality their ovules.

In the same page it is stated that "instances however do occur where the ovules gain a cilium within the cell," &c. I doubt now if these are developments of the ovules, but rather products of the other development which I have shown to take place in *Euglena*,* and consider

* Ann. and Mag. Nat. Hist. vol. xvii. pl. ix. figs. 11—14.

analogous, if not the same, as that described in the Characeæ and in *Spirogyra*, (*loc. cit.*).

It should be remembered that in obtaining the ovules of *Euglena viridis* for development, they should not be forced out of the organism but swept off the sides of the vessel an hour or two after the *Euglenæ*, together with some of the water in which they have been living, has been collected and set aside for settlement.

I have also met with another species of *Amœba* undergoing ovoidal development, viz. *A. verrucosa*, Ehr., precisely like that which I have already described; the *Amœba* perishing as the ovules are developed and ending in becoming a mere ovi-sac.

When first formed, the ovules, which are spherical, consist of a hyaline capsule enclosing a sphere of glairy, refractive fluid, like that of the ovules of *Spongilla* and *Euglena*; but as they begin to develop, this glairy matter becomes transformed into a granular-mucous which is spread over the inner surface of the capsule, and finally the granules present motion, whether of themselves or by aid of the mucous in which they are imbedded, I am ignorant, for thus far only have I seen the development; but I am inclined to think the next stage consists in the whole ovule becoming polymorphic like the ovule of *Spongilla*. This *Amœba* appears to me, for I have watched the development of a group for many months together, to be the adult of my *A. quadrilineata*, and therefore the latter not a new species. The formation and development of the ovules took place in April, and the organism appears to require at least nine months for maturity.

At p. 460 I have stated that I had observed "*Vorticella* developed singly from *Acineta*." This was from inference. I have since been able to follow the gemmules thrown off from the *Acineta*-form of *Vorticella* through their subsequent development, and in no case have seen them take on any other form than that of *Acineta*. The young gemmule at the moment of its exit is, as Stein has stated, exactly like the bud on *Vorticella*, but when pursued to its resting place I have always found it end in becoming an *Acineta*; so that this is not a true instance of alternation of generation. Others, viz. Drs. Lachman* and Cienkowski,† have arrived at the same facts; and these gentlemen also doubt the transformation of *Vorticella* into *Acineta*. Time will prove whether they or Professor Stein are right in this also; in the meanwhile I incline to side with the latter.

* Ann. and Mag. Nat. Hist. S. 19, p. 237, 1857.

† Quart. Jl. Microscop. Sc. No. xviii. p. 96, 1857.

In the same page it is also stated that the sudden contractile movement "of *Glenodinium* unites *Euglena* indirectly to *Vorticella*." I now find that this is not the case, as the "movement" is not one of the whole body or of the body at all, but of the cilium, which floating posteriorly, as that of *Anisonema sulcata* and *Heteromita ovata* (Duj.) &c., every now and then fixes itself by its sucker-like extremity and thus suddenly checks the progression of the organism. Whether the long cilium is also used for progression, or whether this is performed by the aid of the "minute vibratile cilia" noticed and figured by Dr. Allman* I am ignorant, but there does not appear to be a second large cilium for this purpose as in the animalcules abovementioned.

Chara.—At p. 462, in the additional matter which I have given respecting the development of monads from the cell-contents of the Characeæ, it is stated that they are derived from the nuclei which are found free in the protoplasm and in the rhizopodous or polymorphic-cells which exist in it; the nuclei becoming granular and the granules finally passing into monads; and this may still take place, but for the most part it now appears to me that it is the old protoplasm which becomes divided up into monads, after having first abstracted the starch from the dead chlorophyll and converted it into oil, the oil then appearing in a granular form enclosed within the monads; hence the origin of the "granules" mentioned at p. 463.

In the same page I have alluded to the "mulberry shape of the plasma" which we must now consider as the protoplasm. This derives explanation, I think, from the tendency of the protoplasm to assume an actinophorous form, and the radii at the time the pellicula covering them is about to become hardened, not being entirely retracted, but remaining in the pouch-like form which produces the mammillated or mulberry surface mentioned.* That this does take place is frequently evidenced by the whole surface remaining actinophorous; and indeed it is only an instance of the way in which the peculiar forms of many structures are produced, viz. by the hardening of the pellicula upon the shape assumed by the protoplasm. It is therefore not difficult to conceive when the protoplasm and oil is subdivided into monads inside this mulberry-shaped capsule, how the "granules," which are in fact oil-globules surrounded by protoplasm, should get into these pouches.

As regards therefore impregnation or ovular development being connected with this process, we now see that both are out of the question; but still we have to account for the disappearance of the "nuclei."

* Quart. Jl. Microscop. Sc. vol. iii. p. 24, pl. iii, fig. 9, &c.

These, however, might also secrete a pellicula round themselves and undergo the same kind of division as the protoplasm, for they are endowed with a considerable degree of contractile power, though not so active as that of the protoplasm. Certain it is that cells containing no nucleus, as well as a cell containing one or more, will each produce a litter of monads.

I have made these observations first, but they will be better understood after persuing the following abstract of a paper entitled "Transformation of the Vegetable Protoplasm into *Actinophrys*," which was published in the "Minutes" of the monthly meeting of the Society held on the 19th Nov. last :

Abstract.

"The author stated, that when he first entered upon the study of the Infusoria and fresh-water Algae, he had no idea of any union existing between the two, further than that of a gradual approximation of form and organization; and that he was opposed to any sudden leaps from the animal to the vegetable kingdom, or *vice versa*, might be seen by the facts which he had brought forward, in attempting to account for the transformation that takes place in the Characeæ when the contents of their cells undergo the changes which he had described on a previous occasion (see Ann. and Mag. of Nat. Hist. vol. [redacted] 101, February 1856). But latterly his opinions had altered, and he was now compelled to view these transformations as a direct passage of the protoplasm into monads.

"The process which ends in this development, had been called by Naegeli "abnormal cell formation," and Naegeli thought that in some instances germs were thus produced which propagated the plant. Nor could Pringsheim come to any other conclusion than that they were reproductive in *Spirogyra*, where he had more particularly observed them; while the philosophic Alexander Braun, after recapitulating all that had been made known on the subject in his "Rejuvenescence in Nature," adds, "the future will certainly unfold many interesting phenomena in this hitherto little worked field."

"Before detailing his observations on this development in *Spirogyra* which had led to the view abovementioned, the author had thought proper to premise a short account of analogous transformations in *Vorticella* and *Euglena*. In confirming most of what Stein had stated respecting the passage of *Vorticella* into *Acineta*, he observed, that he had never seen the young of the latter assume any other form than that of *Acineta*, but he had witnessed *Amœbae* in the act of throwing

off living *Vorticella*. The passage of the contents of *Euglena* (which organism was much more allied to the vegetable than the animal kingdom) into rhizopods, was a common occurrence, and so nearly resembling that which takes place in *Spirogyra*, that it formed a good transitional link, perhaps, between the passage of *Vorticella* on the Infusorial, and the contents of the cell of *Spirogyra*, on the Algal side, into rhizopodus animaleules.

"It was in the cell of *Spirogyra crassa* (Kg.), (the largest perhaps of the genus) however, that Mr. Carter had latterly been watching these transformations, and it was to these more particularly that he wished to direct attention. The process was simply this:—

"Under certain circumstances the cell of *Spirogyra* apparently dies, the chlorophyll becomes yellow, and the protoplasm leaving its natural position divides up into portions of different sizes, each of which encloses more or less of the chlorophyll; these portions travel about the cell under a rhizopodous form, the chlorophyll within them turns brown, the portions of protoplasm then become actinophorous, then more radiated, and finally assume the figure of *Actinophrys*. The radii are now withdrawn, while the pellicula in which they were encased is retracted or hardened into setæ with the rest of the pellicula, which now becomes a lifeless transparent cyst; another more delicate cyst is secreted within this, and the remains of the protoplasm within all having separated itself from the chlorophyll, divides up into a group of monociliated monads, which sooner or later find their way through the cysts into the cell of the *Spirogyra*; while the latter by this time having passed far into dissolution (not putrefactive) they thus easily escape into the water. Putrefactive decomposition at the commencement destroys this process altogether.

"At first it did not appear plain why the portions of protoplasm enclosed the chlorophyll, but afterwards it was found that this was for the purpose of abstracting the starch which accompanies the latter, since in some cases where the grains of starch were numerous the chlorophyll was not included.

"This was the process when the cells of *Spirogyra* were not pregnant with starch, as they are just before conjugating. When these changes took place at this period they were somewhat different, insomuch as the whole of the contents of the two conjugating cells became united into one mass, and having assumed a globular form, remain in this state until the chlorophyll has become more or less brown. After this the protoplasm reappears at the circumference of the mass in two forms, viz. in portions which leave the mass altogether after the manner of

rhizopods, and in the form of tubular extensions which maintain their connection with the mass throughout. In both instances the protoplasm is without chlorophyll, but charged with the oil-globules, and both forms make their way to the confines of the *Spirogyra* cell, which they ultimately pierce, develope their contents, and discharge them in the following manner :—

“ On reaching the cell-wall, each form puts forth a minute papillary eminence, which, having passed through the wall, expands into a large sac or bursts at its apex. Following the isolated form first, this then gradually drags four-fifths or more of its bulk through this opening, sometimes so much as only to leave a little papillary eminence in it, which then makes the portion of protoplasm look as if it were entering instead of escaping from the *Spirogyra* cell; the internal contents of this protoplasm then become more defined and granular, the granules assume a spherical form respectively, they evince a power of locomotion, and the originally flexible pellicle having become a stiffened cyst, with a more delicate one within (as in the process already detailed) assumes a slightly conical form, which giving way by a circular aperture at the apex, allows the granules to pass into the water, when they are seen to be monociliated monads; each consisting, apparently, of a film of protoplasm expanded over an oil-globule and bearing a single cilium. The contents of the tubular form, on the other hand, undergo the same changes, but the tube becomes dilated into a pyriform shape within the *Spirogyra* cell, and when the monads are ready to lead an independent existence, the end of the papillary eminence which has been projected some little distance beyond the cell-wall into the water gives way, and thus they also escape.

“ In another form of this tubular extension, the inner delicate cyst expands into a flask-like or globular shape, beyond the papillary eminence, outside the cell-wall, and retains the protoplasmic contents here, until they are ultimately developed into monads. These, which are much larger than the monads developed by the other processes, on issuing, move about rapidly for some time by the aid of a strong cilium carried in front like that of *Astasia*, and then become stationary, the vesicula or “contracting vesicle” which does not appear before they leave the cyst, now becomes very active, the cilium is gradually diminished in size and altogether disappears, and the monad passes into a rhizopodous, reptant state, which afterwards becomes actinophorous, and finally assumes a form undistinguishable from that of *Actinophrys Sol.*

“ Up to this point the author had been able to follow this transformation, and although he had not actually seen the actinophorous form

enclose particles of food, yet he deemed the form itself sufficiently significant to guarantee this induction, since he had never witnessed a rhizopod of the kind without attacking everything living and dead that it could overcome and turn into nourishment; besides, such a form could obtain sustenance in no other way. If this was not satisfactory, it was not difficult to conceive that what the portions of protoplasm in an actinophorous form would do within, they would do outside the cell of *Spirogyra*, and it had been shown in the first process detailed, that inside the cell they enclosed chlorophyll and finally ejected the refuse in the manner of *Amœba*. Lastly, the monads which are developed by a similar process in the Characeæ, are frequently seen to issue from the cysts with portions of the brown chlorophyll in their interior, which, as they are not only monociliated but polymorphic from the commencement, they may be assumed to have enclosed after they had become developed from the purified protoplasm.

"The fact of portions of the protoplasm enclosing the chlorophyll for the starch it might contain, had been seen by the author more satisfactorily, in some spores of *Spirogyra*, which were in the anomalous state of being pregnant with grains of starch *without* chlorophyll, while their contents were undergoing the transformations above described. Here there was no colouring matter to impede the view, and the author had repeatedly seen the disappearance of the starch grains directly followed by the appearance of oil-globules; the dividing up of the protoplasm into portions each containing oil-globules, and a gradual lessening in quantity of the oil, indicative of its having become assimilated; while the transparency of the spore generally, enabled the observer to see that the whole of these transformations were effected not by any foreign organism, but by the protoplasm alone.

"It was true that the transformation of the protoplasm of the cell of *Spirogyra* and its movements above detailed, were unlike the phenomena of vegetable life, but the formation of the spore itself in the normal way, and the movements of the protoplasm of the conjugating cells just preceding it, merely required to be studied to bring about the conviction, that one was but a modification of the other.

"In the normal way, the protoplasm of both conjugating cells after having become pregnant with starch (for nutriment during their uterine life as it might be termed) combined, two cysts formed around this mass, the starch passed into oil, and finally the filament was reproduced without the presence of either,—living as before on endosmosis. In the abnormal way, the chlorophyll died, two cysts were formed round the portions of protoplasm respectively, the starch passed into oil, the refuse

of the chlorophyll was thrown off from the enclosed protoplasm in the manner of a rhizopod, the protoplasm divided up into monads which came forth as animals, that is in the form of rhizopods endowed with the power of locomotion and polymorphism, and thus under a form which does not live by endosmosis, but by the enclosure of crude material from which the nutriment is abstracted by a digestive process, and the refuse finally discharged.

"Lastly, the author stated, that whenever a mass of filaments of *Spirogyra* underwent these transformations, the latter were invariably followed by a numerous development of *Actinophrys Sol* of all sizes, to the exclusion at first of almost all other animalcules, and coupling this with the undistinguishable form from *Actinophrys Sol* assumed by the monads developed by these transformations, he saw no other more reasonable conclusion to come to, than that they were one and the same, and therefore that one source at least of *Actinophrys Sol* was the protoplasm of *Spirogyra*.

"Mr. Carter added that these phenomena were easily witnessed, since it was merely requisite to place a mass of the filaments of *Spirogyra crassa* about to conjugate, in a basin of water, and then watch the changes abovementioned, which would be sure to occur in many of the conjugating filaments; but of course, to be understood, they required a practised eye, or to be pointed out by a person conversant with the subject."

*Errata in Article V. of this Number.**

Page 430 line 30, for "Amaeba," read "Amœba" throughout.

" 432 " 41, " "questioned," read "suggested."

" 438 " 37, " "anal," read "oral."

" 440 " 5, " "found," read "formed."

" 443 " 24, " "*Colacium vesiculosum*, Ehr.," read "the young of *Cyclops quadricornis*."

" 447 " 16, " "*Amœba (diffusa mihi)*," read "*A. Gleichenii*."

" " 32, " "not," read "seldom."

" 450 " 2, " "*Euglena deses*," read "*E. viridis*" throughout.

* For illustrations and additions to this Article, as well as to Art. X. on the "Development of the Root-cell and its Nucleus in Chara," see Annals and Magazine of Natural History, vol. xviii. p. 115 for August 1856, and vol. xix. p. 13 for January 1857, respectively.

ART. XIV.—Extract from a Report on Attempts made to supply Aden with Water. By Lieutenant H. St. C. WILKINS, Executive Engineer, Aden. Communicated by the Government.

Presented 9th April 1857.

WHEN Aden was first taken possession of by the English in 1839, the inhabitants procured water for domestic and other purposes from a few wells in the valley of Aden, that is, from the crater of the extinct volcano : no wells were then in existence outside the crater. Some tanks, half in ruins and filled with rubbish, were found on the sides of the mountains, judiciously placed, and finely plastered, but appearing to have been in disuse for a long period. In an Arabic work, entitled "A brief history of Yemen," it is stated that the wall outside, and the reservoirs within Aden, were built by the Arabs before the year of the Hejra 906 (A. D. 1490), and that the governor of the rich town of Aden (the passage round the Cape, discovered in 1498, diverted the Indian trade from the Red Sea) then dug wells for sweet-water, and was successful. It may therefore be inferred, that from the time when water was thus procured, the tanks and reservoirs were suffered to go into decay ; and perhaps another inference may be drawn, that

water obtained in the reservoirs was not so good as the well-water, although nearly all the latter must have been brackish.

2. Regarding the origin and nature of the fresh-water springs in the valley of Aden, two theories have been put forward: one, that fresh-water from the main-land of Arabia percolates through substrata of sand under the sea, and thus reaches the peninsula of Aden; the other, that the springs are entirely supplied by the rain which falls on the peninsula, and from heavy dews.

3. The first theory was put forward in the early years of our occupation of Aden, and was adopted by the Special Committee appointed to determine upon a definite plan for the defence of the peninsula of Aden. They acknowledged the difficulty of the question, but, after due consideration of the various reasonings in support of each theory, they came to the conclusion that the theory of percolation of water from the main-land through a pervious bed under an impervious bed of rock or clay, was entitled to their belief, and for the following circumstances:-

The water in most of the wells in the valley of Aden was found at a level below that of the sea. The wells, within the memory of the oldest inhabitants, had never been known to be dry, excepting after an unusually heavy draught from them in the day, and then they filled in the night, and the water next morning was found to be at ordinary height. Little or no rain fell on the peninsula, seldom exceeding two inches in the whole year, and what little did fall became discoloured and putrid in two or three days when collected in tanks, so as to be quite useless except for washing. The water in the wells seemed to be nearly independent of all local circumstances of wind, weather, or seasons. The many wells containing water too brackish for drinking purposes were those nearest the sea, and supposed to be under the influence of filtration of sea-water. At Shek Othman, on the sandy plain, seven miles distant from Aden, good well-water was procurable, the soil apparently being the same as at the isthmus at Aden. The Committee, on looking down from some of the rocky cliffs washed by the sea, especially at Ras Marshag, in Holkut Bay, and also near Ras-el-Erigh on the isthmus, had seen a bubbling effervescence rise to the surface of the sea from the bottom, appearing to be occasioned by a spring of fresh-water forcing its way up through the sea. The Committee wished to follow up the investigation of these sub-marine springs in order to develope their true character, but the iron tubing applied for did not arrive until they had left Aden. They considered it within the range of possibility that these springs might turn out to be perennial

and valuable springs of fresh-water, similar to the springs of fresh-water in the sea at three fathoms depth off the island of Bahren in the Persian Gulf, vessels procuring the fresh-water by sending a diver down with an empty mussuck, or by securing a hose to the fresh-water spring-head at the bottom of the sea; and it was said that better water was procured in this manner than could be obtained on the island itself. Considering the small quantity of rain which fell on the Aden peninsula, these sub-marine springs were supposed to be springs of water from the main-land.

4. The Committee then adopting the theory of percolation from the main-land, considered it highly desirable that the experiment of boring on the plain of the isthmus should be tried. The experiment was considered a simple one, and the Committee were pretty sanguine of meeting with the water which supplied the wells of the valley of Aden.

5. A spot about half-way between Jeb-el-Huddeed and Ras-el-Girref was chosen, and the boring operation commenced. The Committee were of course in hopes of meeting with an impermeable bed of rock or clay below the sand, and by boring through this impermeable bed they anticipated coming upon a permeable bed of sand again, and fresh-water; but the boring operation proved anything but simple, for, at a ~~few~~ feet below the surface of the plain, salt-water from the sea drained into the bore, and tubing had consequently to be used to exclude the salt-water, and this rendered the operation of boring extremely laborious and difficult. Colonel Grant thought the experiment should not be given up as a failure until upwards of 200 feet in depth had been attained, but Captain Kilner found he could not drive his 8-inch tubing more than 72 feet; he afterwards drove 5-inch tubing 98 feet, and an auger $14\frac{1}{2}$ feet, but it was found impossible to keep the salt-water out of the pipes, and so, whether fresh-water had been met with or not was never determined, as only sand with pebbles was bored through: it may, however, be considered that this boring experiment was a failure.

6. Numerous experiments were made in various parts of the peninsula outside the crater by blasting and boring, in the hopes of meeting with springs of fresh-water, but all these attempts proved unsuccessful.

7. The Special Committee recommended that a bore or well should be sunk on Flint Island, to be carried to a depth below all probable access from sea-springs; but their recommendation was never carried out.

8. The various attempts that have been made for increasing the supply of water at Aden, and their results, are as follows :—

Boring where tried.	To what depth carried.	Results and Remarks.
No. 1. At the head of the valley between Ras Morbut and Ras Tarshayn, Steamer-Point.	68 feet.	This experiment was tried by Lieutenant Western, in 1839-40, and only salt-water met with.
No. 2. At the head of the valley between Ras Morbut and Ras Tarshayn, Steamer-Point.	This second experiment had a similar result to the above.
No. 3. In Western Bay, close under Shumshan Mountain.	98 feet.	This bore was carried down 98 feet by Lieutenant Western. Pure salt water was met with at this depth. As the bottom of the bore was however between 70 and 80 feet above high-water mark, the unexpected result met with was rather difficult of solution. It was considered casual, but this meeting with salt-water at so high an elevation above the sea is a proof against the Committee's theory, and strongly in favour of the second theory, which will be hereafter alluded to.
No. 4. On the isthmus under Durul-el-Hosh.	50 feet.	Lieutenant Western found very brackish useless water at 50 feet, so the boring was stopped.
No. 5. On the isthmus under Durul-el-Hosh.	60 feet.	Lieutenant Curtis, Executive Engineer, conducted this bore, and found similar water to the above. The experiment was

Boring where tried.	To what depth carried.	Results and Remarks.
No. 6. In Western Bay, about half a mile lower down the valley, nearer the sea than No. 3.	205 feet.	discontinued, the breaking of the tools preventing its being persevered in. A well was then sunk at this spot, 54 feet, in order to extricate the broken jumper. The men working at this well being required for more pressing work, it was discontinued. At the depth of 54 feet it was found quite practicable to keep the excavation free from water, by means of hand buckets. It was remarked that the water which oozed in on the southern or Aden side, was perceptibly sweeter than that from the isthmus side—another proof in favour of the second theory.
No. 7. Behind the Prince of Wales' Hotel, Steamer-Point.	38 feet.	At 57 feet brackish water was found, which gradually became worse. From the depth of 162 feet below the surface, to 191 feet, clay was found, with here and there stones in it. This clay was perfectly sweet below 191 feet ; the bore went through clay and gravel mixed, and eventually gravel alone, which was very similar though coarser than the gravel in which sweet-water is found in Aden. The breaking of the jumper, too close to the end to allow of its being extricated, compelled Lieutenant Currie to discontinue this bore, but he considered it sufficiently indicative of success to authorise his suggestion to the Military Board that a well should be sunk on that spot.
		At 25 feet, when the boring began, such extremely hard rock was met with, that only two inches could be got through in three days ; the well was then excavated 12 feet by blasting, when the work was discontinued.

Boring where tried.	To what depth carried.	Results and Remarks.
No. 8. Boring on the plain at the isthmus.	147½ feet.	Captain Kilner drove 8-inch pipe 72 feet, and 5-inch tubing 98 feet; he also drove an auger 147½ feet. It was found impossible to keep the salt-water out of the tubing. The driving of the tubing, and the boring, was an extremely difficult operation, the tubing was fractured and other accidents occurred.

9. After these experiments, boring for water was discontinued ; it was not considered worth resorting to any further, as in case of accident occurring to the boring implements, as mentioned above in cases 5 and 6, the experiment had to be commenced again *de novo* ; and even if the experiments were successful, it would be necessary to dig a well afterwards, and build up with permanent masonry—an expense that exceeds but little that of boring when hard rock is met with, and in some instances the expense and difficulty of boring exceed even that of digging a well, as when a succession of iron-tubing is necessary beyond a certain depth to exclude sand or salt-springs.

10. The utility of boring then at Aden appeared to be limited to the discovery of the spot where permanent wells might be successful, by a somewhat speedier, and, in some instances where rock is not met with, a cheaper process than well-digging.

Experiment.	Depth attained.	Results and Remarks.
No. 9. Well under Ras Meil, eastern extremity of the line of isthmus works.	43 feet.	This well was carried to a depth of 43 feet, with a diameter of 15 feet. At first the water was stated to be particularly good. The Civil Surgeon wrote, saying, the water was certainly not salt-water—“It contains sulphate of soda, sulphate of potass, a small quantity of nuriate of soda, with a little uncombined carbonic acid. I think it comes from the same source as the water in the wells inside

Experiment.	Depth attained.	Results and Remarks.
No. 10. Under Ras Meil, a few yards from the well above mentioned.	<p>"the town. The specimen of stone "which accompanied the water, and "through which it rises, is a fresh-water "formation."</p>
		<p>However, Dr. Herbert Giraud, Professor of Chemistry in the Grant College, did not coincide exactly in opinion with the Civil Surgeon at Aden, for he wrote regarding the same water, a sample of which had been sent to him for analization—"Water for use generally contains only one part of saline matter in 8,000 or 12,000 of water; any water containing more than one part in 2,000 is unfit for such purposes. The Ras Meil well-water contains 29·5 parts in 1,000 of water, making it identical with sea-water (sea-water contains from 20 to 44 parts in 1,000). The presence of the characteristic element, bromine, completed the resemblance."</p>
		<p>The Special Committee wrote concerning this well—"At first the water in this well promised to be particularly good, but now the sea-water has apparently penetrated into it, so that its water differs but little from that of the sea."</p>
		<p>This well was commenced before the well last mentioned, a few yards lower down the ravine. The water found was stated to be very good, but the well being thought too near the sea, the well last referred to was commenced, and this one left with only a small hollow in it containing about 2 feet of water. This</p>

Experiment.	Depth. attained.	Results and Remarks.
No. 11. Well dug in Western Bay near Little Pass.	67 feet.	<p>same water is afterwards described as being very unpleasant to the taste, bitter, and sulphurous, but not very salt. The Special Committee wrote—“There evidently appears to have been a small quantity of fresh-water in this spot, but the soil being of a loose description, as the depth of the well was increased so the sea-water penetrated into and destroyed it.”</p>
No. 12. Well be- hind Prince of Wales' Hotel.	42 feet.	<p>This well, 18 feet in diameter, was excavated to a depth of 67 feet, through soil capable of removal with a pickaxe; no blasting was used; but the sea-water penetrated into it to such an extent, that although three parties were employed for several days and nights without intermission, they were unable to reduce the quantity.</p>
No. 13. Well near Ras Morbut Battery.	50 feet.	<p>This well I suppose to have been excavated at the original bore (vide No. 7): it was excavated 12 feet in diameter to a depth of 42 feet; 30 feet was excavated with the pickaxe, the remaining 12 by blasting in very hard rock.</p>
No. 14. Well at the Hedjaff, Western Bay.	<p>This well (perhaps identical with the bore, vide No. 1) was excavated 12 feet in diameter to a depth of 50 feet, partly by pick and partly by blasting. It was discontinued at this depth.</p>
		<p>A well was excavated at this place last year. It was hoped that water would be found available for the Irregular Horse, for washing and such purposes; but the</p>

Experiment.	Depth attained.	Results and Remarks.
No. 15. Well in Western Bay under the cliff opposite the Biggarees' Hospital.	65 feet.	water was found to be identical with sea-water.
No. 16. Well at the Hedjaff, high up the valley.	44 feet.	This well was excavated by a private individual last year. Drinking water was found. The well yields about 20 gallons per diem. The water in this well is about 60 feet above the level of high-water mark.

11. These I believe comprise most, if not all, the experiments which have been made by boring and well-digging for increasing the supply of water at Aden. In the valley of Aden numerous old wells have been cleaned out and deepened, with more or less success. Some, carried down upwards of 200 feet, have disappointed the explorers; others have given tolerably sweet water; and some, water too brackish to be drinkable. No really sweet water has been discovered, neither has any inexhaustible supply of drinking water been found.

12. The well containing the best water in Aden is the Bir-ul-Dowlah, in the Kussaf valley. This well is 18½ feet in depth. It is an old well, and at the time of our occupation of Aden it was only 18 inches in diameter, and I believe it is the same depth now. It was not a straight well; and when, in 1844 or 1845, the well was increased to 18 feet in diameter, the drift-way of the old well was found to have turned out of the directly vertical line to avoid hard rock. How this well was originally sunk only 18 inches in diameter and tortuous, is a question difficult to solve. However, the water taken from the well being nearly if not quite sweet, it was enlarged to a diameter of 18 feet, and the Special Committee hoped to increase the supply from it sufficiently to furnish the whole of the troops with its water.

13. The supply, however, was never increased; it gives about 140 gallons per diem.

14. In the Hydross valley, in the Aden crater, are numbers of old wells, most of them filled with rubbish and débris. Were these excavated, water would undoubtedly be met with, brackish or otherwise of course can only be determined by experiment.

15. To turn now to the second theory regarding the nature and origin of the fresh-water springs at Aden—that these springs derive their supply “from rain which falls on the peninsula and from heavy dews.”

16. The numerous experiments of boring and well-digging which have been made, prove something. They perhaps do not prove the truth of the second theory, because, volcanic action having so completely broken up the original formation of the rocks and substrata, well-digging and boring at Aden must be by a fortuitous chance successful, and the sites selected for the experiments detailed may have been ill-chosen or unlucky. Still, water outside the crater of Aden has been met with, but it has been salt or very brackish. How then are the wells in the valley of Aden supplied? how is the Bir-ul-Dowlah supplied? The bottom of this well, containing ~~the sweetest water in the place,~~ is 100 feet above high-water mark! By the first theory it is an Artesian well, by the second simply a land-spring.

17. If it be an Artesian well, sweet-water from the main-land of Arabia must percolate through a porous stratum. The rain-fall upon the surface of the porous stratum soaks through it, until it meets with a retentive substratum; the water then follows the lowest levels of the permeable stratum, but the sea intervenes, and therefore the porous stratum must have impermeable stratum above it, by which the salt-water is kept from mixing with the sweet.

18. Supposed formation to account for the Bir-ul-Dowlah well being Artesian:—



If the Bir-ul-Dowlah well, then, be Artesian, the water which sup-

plies the well comes from the main-land at W. The bottom of the well is 100 feet above the sea ; of course then W must be 100 feet or more above the sea level, and we may suppose the flow of water to be regulated by the same laws below as above ground.

19. Now the peninsula of Aden is composed of unstratified basaltic rocks. Volcanic action has completely broken up its original formation. The Bir-ul-Dowlah well *may* be an Artesian well, but it is not probable.

20. If the Bir-ul-Dowlah be supplied from a land-spring, rain on the peninsula must be the origin of the supply. The surface of a district over which rain falls or flows, consisting of a loose permeable material lying upon a retentive substratum, water soaking through the above collects in any depression of the upholding bed. The Bir-ul-Dowlah well, then, has been excavated over a small depression of this description.

21. The wells in the crater of Aden are all situated in valleys which receive the drainage from the Shumsan range of mountains and an extensive plateau below.

22. There are ~~sixty~~ 31 wells of sweet-water in the Kussaf valley, the Bir-ul-Dowlah being one. Some give 3,000 or 4,000 gallons of sweet water per diem ; others but a very small quantity. Some wells are 100 feet above the sea level, others far below it ; these wells are very close to each other. Can they then be Artesian wells ? must they not be supplied by land-springs ?

23. In experiment No. 5 on the isthmus, the water which oozed into the excavation on the crater side was considerably sweeter than the water which oozed in on the isthmus or sea side.

24. Very little rain falls on the peninsula of Aden. The Special Committee stated that the quantity did not probably exceed two inches in the whole year.

25. The quantity has never been very accurately ascertained,

In 1834 the rain came down twice.

„ 1837 once.

„ 1839 once, very heavily, with a rush of water.

„ 1842 once ; 5½ inches fell in 3 hours.

„ 1846 once ; a very heavy storm.

26. From the above it would appear that heavy storms at Aden occur thrice annually.

				Inches	Cents	
27.	In	1850	..	5	0	of rain fell.
	"	1851	..	1	50	"
	"	1852	..	6	25	"
	"	1853	..	0	75	"
	"	1854	..	6	65	"
	"	1855	..	2	70	"
	"	1856	..	1	46	"
Total in 7 years ..				<u>24</u>	<u>31</u>	
Average fall in one year ..				<u>3</u>	<u>47</u>	

Several showers are unrecorded in the above.

28. The valleys in which the wells of Aden are situated receive the drainage of the north-eastern side of the Shumsan range of hills, and also of a large elevated plateau between the Aden valley and the hills. During the heavy falls of rain which sometimes occur, water from the hills rushes down the narrow and precipitous valleys with great violence, much damage is done to the town, and a considerable quantity of water escapes into the sea. Where the water falls on or rushes over loose or permeable beds, it of course soaks through until it meets with a retentive substratum.

29. I will endeavour to deduce what this drainage is, and in doing so I will, for fear of exaggeration, take the lowest data consistent with accuracy.

30. I have shown that an average of seven years' rain gives a yearly fall of 3·47 inches, and several showers were unrecorded during the seven years; but I will not increase the quantity on that account.

31. In England the depth of dew in the year has been found to be 5 inches. Dews in Aden are occasionally very heavy. I shall perhaps be rather under the truth in taking the depth of dew in Aden at 3 inches.

32. The rain and dew together, therefore, give 6·47 (six inches forty-seven cents) of water yearly.

33. Two-thirds of the depth of rain and dew has generally been allowed for escape by evaporation; but from calculations made of the discharge from the Thames, and the area of land drained by that river, two-thirds has been found to be rather too large an allowance for evaporation. I will, however, take two-thirds of the depth of rain and dew for the loss on account of evaporation; 2·15 (two inches fifteen cents) will remain.

34. From the plan of Aden it will be seen that the valleys of the

wells receive the drainage of an area two and half miles long by one mile broad.

35. This area comprises 69,696,000 square feet ; taking the depth of water as 2 inches, the total supply of water is 11,616,000 cubic feet : 1 cubic foot = 6.2321 gallons, 11,616,000 cubic = feet 72,392,073 gallons, omitting decimals.

36. The daily issue of water from the wells in the Aden valley is 15,000 gallons : $15,000 \times 365 = 5,475,000$ gallons, the yearly issue of water from the wells ; that is, the largest supply of water that can be obtained from the existing wells.

37. $72,392,073 - 5,475,000 = 66,917,073$ gallons, the surplus of rain and dew in the year over the issue from the wells.

38. As I have before stated, a great quantity of water during heavy falls of rain escapes into the sea ; but it is nevertheless apparent that the quantity of rain which falls on the peninsula of Aden together with the dew, is a sufficient source of supply for all the wells which now exist in the valley of Aden.

39. The Bir-ul-Dowlah may be said to be the only well which gives really sweet water, all the other wells are more or less impregnated with salts. Some wells in the lower part of the valley may be impregnated by filtrations from the sea, but probably the brackish wells are so in consequence of the many salts contained in the rocks and earth of the peninsula, which are taken up by the water in its filtrations.

40. In experiment No. 3 it is stated that salt-water was met with 70 or 80 feet above high-water mark ! The unexpected result could not be solved. It is probable that the water found was not sea-water at all, but fresh-water highly impregnated with the salts of the earth.

41. In experiment No. 9 the water found was not only salt but very nauseous and mephitic ; and in experiment No. 15 a small quantity of sweet-water has been found some 60 feet above high-water mark.

42. Are the wells not then supplied by land-springs ?

43. Several schemes for damming up the ravines in the valley of Aden have been proposed, but none have been carried out.

44. In 1848, Major General (then Lieutenant Colonel) Waddington submitted a plan and estimate for damming up the valley above the Banian well, but the Government of India refused to sanction the work proposed.

45. In the Tawelah valley, Lieutenant Playfair, Assistant Political Resident, has discovered a series of fantastically shaped tanks : these tanks have been probably neglected since A. D. 1498, and gradually filled with rubbish and débris from the hills. They were buried many

feet below ground. The discovery has led to stricter search, and the whole of the Tawelah valley to the town is covered with tanks. A number of tanks at the head of the valley have been cleared out by Lieutenant Playfair, who anticipates retaining in them the first heavy fall of rain, some three and half millions of gallons. When all the tanks he has found are cleared out, he estimates their capacity at twenty millions of gallons.

46. Will not Brigadier Coghlan and Lieutenant Playfair's attempts to increase the supply of water in Aden by clearing out these tanks prove successful? It is to be hoped so; but it has yet to be proved practically whether the water retained stagnant in these small tanks will keep pure and good for drinking. In any case the water will always prove most useful.

47. Probably the best plan for increasing the supply of water in Aden would be, by building dams across the ravines high up, similar to the plan referred to in para. 44. These dams would retain water and increase the filtration through the permeable and loose beds above the wells, and so increase the supply in the wells.

48. No amount of sweet-water has as yet been found outside the crater of Aden. Many attempts have been made in Western Bay. The wells when excavated high above water-mark have not rewarded the sinkers, and when the excavations have been made low down in the valley, sea-water has only been met with. Western Bay is probably about the least likely place in the peninsula in which the search for water would prove successful.

49. In some of the bays on the south-western side of the peninsula sweet-water might be found, if the site for the well be judiciously chosen as regards water-shed, area drained, and the probability of sea-water filtration avoided.

50. The Huswah scheme has, I believe, failed, and in my humble opinion the only method by which the supply of sweet-water at Aden could be materially increased would be by repairing the old aqueduct, from Shek Othman or Bir-Ahmed on the main-land. If, in former times, the aqueduct was found to be of value; surely at this period it would prove to be so also.

51. Few branches of natural history have given rise to so much discussion as the theory of springs. It is impossible for any one to say for certain that the Aden wells are Artesian or supplied by land-springs; but from the experiments and attempts to increase the supply which have been made at various times, and of which mention is made in this Report, I think a conclusion hardly doubtful may be arrived at, and

in conducting any future search on the peninsula of Aden for sweet-water, perhaps the investigations I have made, and the deductions which I have drawn, may not prove valueless.

ART. XV.—*Letter from F. Broughton, Esq., Assistant Surgeon H. C. S., to the Rev. Dr. Wilson, Honorary President, on Cave-Temples near Wagotun.*

Presented February 1857.

MY DEAR DR. WILSON,—In September last I passed a few days at a place called Wagotun (from Wagostan, a country of tigers), near Viziadroog, on the western coast of India; and bearing in mind our cave-temple inquiries, I was fortunate enough to discover some excavations not previously described, and an account of which may be interesting to you, as completing my former observations, and carrying them to the coast.

Wada Parell is two and a half kos from Wagotun and about seven miles from the sea. The approach is difficult, as the traveller has not the advantage of anything in the shape of a road, but must pass over one continued slippery and undulating surface of sheet rock. On arrival, however, this exertion will be amply repaid to any one appreciating beautiful scenery, or curious in antiquarian research. The village is situated at the mouth of a prettily wooded ravine, surrounded by palms, and magnificent specimens of the Kajra (*Strychnos nuxvomica*). Crossing a stream you ascend the ravine, at the upper sharp of which this temple is found, together with one or two cells of the ordinary character so frequently seen in this country.

As may perhaps be surmised from the accompanying sketch, the outer verandah is artificial, having been recently added to the excavated frontage. The verandah is 14 feet wide, and constructed of laterite. Passing through you enter the rock-cut temple, 24 feet long by 28 feet wide. Three pillars are left on either side, and separate the hall from a side verandah 10 feet wide abutting upon the rock. The pillars are 12 feet high, carefully though not richly carved, and provided with base and capital. Walking forward in the centre, twelve

stairs conduct you into an inner temple, 15 feet by 12, and 6½ feet in height. This recess has a flat roof and contains a lingum.

Outside on either flank are two elephants, also cut out of the solid rock, each animal being provided with a block of stone upon which he rests his trunk, and each being surmounted by a deified mahaut.

In front of the temple are other figures with obscene details. These are not (as I at first suspected) recent additions, but form part of the original design. A few dipmals occupy the paved courtyard extending to the brink of the stream.

By ascending a painful series of steps on either side, the devotee passes up to the table-land above this temple, and, descending on the opposite, accomplishes the sacred circuit. Following the track of the circum-ambulator, I found that a deep trench had been cut round the entire temple from above and behind. This is evidently done to preserve the same from the action of the monsoon, as connecting channels are observed below. For this purpose also the roof and verandah have been covered with chunam. By this cutting, which is 3½ feet wide, this entire temple is rendered monolithic, the recesses for the elephants in front but slightly connecting it with the parent rock.

The oft-told tale of the excavation of this temple by Pandoorung, and its completion in a single night, was all the information I could obtain from the shabby-looking residential ecclesiastics with whom I conversed. It is, I think, of Hindoo origin, and may be perhaps remarkable from its size as a monolithic temple.

Excavations of Sagwa.

About eight miles south of Wagotun, on the bank of the river, is a little fishing village, called Sagwa. Close to this village, and as usual situated in a most romantic, well wooded, and amply watered ravine, are the excavations of which I had received information. On approaching the scarp, two sadly ruinous temples and several cells were discovered pierced into the once solid rock. The largest temple was only 14 feet by 10, supported by four slightly ornamented pillars. The action of the monsoon, and the chemical action consequent thereupon, have broken up the face of this scarp, and the original nest of cells, the temples, and portions of a connecting stair-case now lie in a confused heap of ruin. From the remains of ancient pathways favourable to circum-ambulation, I conclude these also to be Hindoo. Incessant rain prevented my obtaining any sketch of this pretty spot. According to the traditions of the people our friend Pandoorung was also the author of this group, and marks of his hand are pointed out as evi-

dencing this fact and indelible in the hardest rock. It then seems probable that the experience he derived from the destruction of this series may have induced him to isolate and so preserve the temple at Wada Parell in the manner previously described.

Cavern at Motad.

I also visited a cavern at a place called Mootad, worth describing, although never, I am disposed to think, intended for any worthy purpose. Close to Wagotun a stream of some size and rapidity suddenly sinks among the rocks forming its bed, and emerges again deep down at the bottom of an adjoining ravine. By some disturbance of the rock, the stream, instead of passing over the edge and forming a cascade, found a natural channel and a nearer way of arriving at its destination. In the course of this natural channel there was an enormous cavern, 120 feet long, 40 wide, and 11 in height, all access to which was cut off by the stream above and below passing through it, and it could only have been discovered by some person entering from below in the dry season.

The discovery however took place, and stair-cases were cut down through the rock above into the cave, and a canal 18 feet deep by 3½ feet wide dug out below through the entire length of the cave, which seems natural, although small excavations on the upper sides appear artificial. By this canal the water passes through, leaving the cave dry and spacious even in the rains. The apertures above seem formed for concealment, and stones easily close the entrances of the stair-cases.

The object of such gigantic labour must have been very urgent and probably illegal. I am disposed to think it must have been a retreat for the piratical hordes who so long infested this coast. It is a convenient distance from Viziadroog, and in all probability its recesses frequently enabled the outlaw to bid defiance to pursuit.

The singularity of this retreat must be my excuse for troubling you with a subject so foreign to the immediate object of my communication.

Believe me, &c. &c.,

Kolapore, 20th January 1857.

F. BROUGHTON.

ART. XVI.—*On Contributions to the Geology of Central and Western India.* By H. J. CARTER, Esq.

May 1857.

Central India.—To no one is the Society more indebted for contributions to its museum from, and interesting notes on, “fossil sites” at and about the neighbourhood of Saugor in Central India, than Captain W. T. Nicolls, of the Madras Army. His last present, which was made on his leaving Saugor in bad health on the 8th April 1851, amounts to upwards of 500 specimens, consisting chiefly of portions of the limestone, argillaceous strata, and fossils from the intertrappean lacustrine deposits, silicified wood, trap, and sandstone at Saugor; of silicified wood, and bones of large mammals ~~infiltrated~~ with silica from Narrainpoor, about 17 miles SE. of Saugor; and of fossil-bones, shells and wood from the conglomerate of the valley of the Nerbura at Burman Ghât and its neighbourhood, about 60 miles south of Saugor, all numbered, catalogued, and described with much useful and interesting detail. A great number of the specimens of wood, agate, and sandstone have been beautifully polished, and the whole forms a geological collection which, in point of bulk and value, exceeds any that has ever been made to the Society.

One of the most interesting of Captain Nicoll's written communications is his description of one of the sites at Saugor where fossil palm-trees are found, and this we shall give in his own words, only altered and abridged a little, to avoid references to the plan which accompanied it, ~~but~~ which the clearness of his description renders unnecessary to print.

Memorandum to accompany a Section and Ground-Plan of a Fossil Palm-tree discovered at Saugor. By Captain W. T. NICOLLS, Madras Army.

“There is a spot near Saugor traditionally known to a few people as a place where fossil palm-wood is to be found; it is, however, so little marked by the fossils on it, that I have known people walk over, with-

out discovering it. Having casually heard of this place some three years since, my attention was given to verifying the report, and I think I have done so successfully.

"The locality has been cursorily described by Dr. Spry, in the Journal of the Asiatic Society of Bengal; but the fossils are incorrectly represented there as lying on limestone.

"Small fragments of fossil palm-wood are found on the cantonment side of the nullah [water-course], particularly about the Babul tree, (c Plan) and between it and the nullah; also, on the opposite side of the nullah an occasional specimen may be found all along the edge of the trap; but none exists on the lacustrine intertrappean limestone which is exposed in the bed of the nullah, and in other places on its further bank where it has been denuded.

"From the fragments being on the surface of the black-soil, I concluded that they must have been fossilized there; and, having been fossilized there, it was unlikely that the palm-trees from which they came could have grown elsewhere, there being no suitable soil for them; while they bore no marks of having been embedded in any other matrix. Formerly (I learnt from Dr. S.) there were cart-loads of these fragments at this place; so that, altogether, I conclude that this was both the site of the growth and fossilization of the palm-trees from which they came.

"The quantity of root-pieces too, and the mention by Dr. Spry of fine root-fibres uninjured, and two large entire root-stems which were dug up at this place by a Sangor lapidary, led to the same conclusion; and conceiving that a heated outflow of trap was the immediate petrifying agent of these siliceous fossils, I sent a person to hunt for further fragments along the junction of the trap with the black-soil. Here a Gowlee pointed out to my man a place where a log of three feet long had been dug out from the surface of the black-soil close to the edge of the trap, and, on searching here for more, I established beyond doubt that the black-soil contained fragments of silicified wood which had never before been disturbed. I had intended to have gone further, but delaying, a stone-cooly occasionally in my employ turned his hand to the spot, and he also brought me one or two large pieces of palm-wood; after which he brought more, one of which exceeded two feet long, and was about nine inches in diameter. All these came from the black-soil, and were internally of a deep black colour varying to rich chocolate.

"Wishing now to discover a tree *in situ* and so set the question at rest, I took the matter into my own hands; and for this purpose dug an adit three feet broad and twelve feet long into the trap where it

mixes with the black-soil. I then dug another across the head of this for six or seven feet, when, finding only a small piece or two of palm-wood, I pursued the original direction, and found that for six or seven feet and to within about seven inches, lay a palm-tree parallel to the first adit. It was buried at the depth of four feet in the trap and black-soil.

"Section (*d* Plan) represents the exact position with regard to the trap, and the level and divisions of the tree from measurement from a base line. The tree was silicified and divided transversely into 26 pieces, and the largest, viz. the root-extremity, was 2 feet 10 inches, while the shortest was not more than seven inches long. The total length of the tree was 31 feet 3½ inches, including 9½ inches interval between the pieces; but this, by the mode of measurement, viz. on a straight line, would be nearly made up, as by the ground-plan it will be seen that many of the pieces lay obliquely. By the ground-plan, too, it will be seen that the root had not been measured, so that the tree actually measured between 31 and 32 feet long; it was 7½ inches in diameter at the small extremity, one foot at the base, and 2 feet 6 inches in the root. For 20 feet of its length the tree lay in trap-lava, and nearly on a level; and for nearly two-thirds of the remaining part, viz. 11 feet, on trap with black-soil above; the last 3½ feet entirely in the black-soil, but still with the trap not far below all. The two first or root-pieces had undergone displacement, and their heaviest ends lay deepest in the black soil.

"This tree could not have been fossilized before it became recumbent, or the fall would have shattered it to pieces. For 20 feet from the root there is but one interval of an inch and a half long between the pieces longitudinally; but they have undergone considerable lateral displacement, probably from the pressure of the trap against them. This alteration in level and lateral displacement in the first 20 feet which was in the trap, appears to afford evidence of the trap having been in a yielding state after the tree had been broken into pieces, which again must have taken place after it had become fossilized.* It is very evident that an unlapidified tree could not break into pieces transversely with straight even fractures; I therefore suppose that the fossilization and displacement must have both occurred whilst the trap was unconsolidated,* and must have been very speedy. The same remarks apply to that part of the tree, viz. 3 feet 6 inches, which was in the black-soil; it must have been fossilized there also.

* The succession of an earthquake might do the latter, as the separated fragments of a previously solid rock, which has thus become a breccia, often prove.—ED.

" I have mentioned that the pieces of fossil-wood found in the black-soil are differently fossilized and of different colours ; so it is here. The pieces Nos. 1 to 4 are dark, and a section of No. 5 is also dark ; besides, this piece (2 feet 6 inches long) appears to have had a longitudinal fissure before fossilization, for one part is dark and the other whitish blue, the line of separation being at the crack or fissure.

" In section (*d* Plan) at piece 9 the prostrate tree had come in contact with an upright one, also fossilized in the same manner, but I do not attribute the angle here presented by the remaining third of the former, to its having met with the latter, although the prostrate, presses against the upright, stem, but to the flow of trap being at a higher level here than where the remainder of the tree lay.

" The prostrate tree must have been upturned simultaneously with the outburst of trap, and probably borne along with it for some slight distance, as trap for a short way underlies it. The roots, which are all fossilized, are imbedded in the brown chocolate soil in which the tree grew, and they could not have been much exposed to the washing of water, or there would not have been so much of the soil left about them.

" The depth of trap under which the tree was buried nowhere exceeds 4 feet 10 inches, which seems scarcely enough to have overset a tree of this height ; but the tree is underlaid by trap, and therefore may have had a depth of 7 to 8 feet against it, or it might have been blown down previously or at the time of the outburst by wind.

" Section (*d. e. d.* Plan) is the upright palm-tree to which I have alluded, against which the prostrate one was laying ; the dimensions are the same. Its root was found ten inches below the rest but still upright, resting upon the intertrappean hole, mixed apparently with altered trap. I cannot account for the separation of these heavy pieces in an upright trunk, unless this took place when the trap was soft, but here again the root rested on the alluvium ; the tree may nevertheless have been slightly removed and the alluvium may not have been the exact spot of its growth, as it was somewhat mixed with trap.

" A detached piece was found, also probably belonging to this stem, in which the greater part of the root appeared to have rotted away and the remainder only to have become fossilized.

" In the floor of the adit, which was composed of trap, a large block of palm-wood was found completely enveloped by trap, and a small portion of black-soil with it ; this piece of wood contained blue agate-veins like the fossil palm-wood in the valley of the Nerbudda.

" *Matrix.*—This is much the same as that shown in the plan, viz. black-soil and trap mixed. The black-soil about the upright tree

contains quantities of broken agates, which have fallen into it through cracks : such agates do not exist in the amygdaloid or in the trap, but on the surface of the latter and of the black-soil ; they appear to be some of the latest of the igneous results, and seem connected with the trap ; some contain fragments of fossils. At the end of the cross adit near the root of the tree the black-soil was mixed with trap, also at the entrance of the adit on the right hand side. In many parts the black-soil had entered deeply into the cracks in the trap, and within the black-soil again, lime was deposited. The divisions between the pieces of the tree were filled with black-soil. I did not see the tree removed, but on taking up one piece, about the centre, which lay under the trap, it was observed to be within two or three inches of the black or brown soil which was below ; this differently coloured soil might have arisen from decay of the outer wood.

"About forty-five paces SW. of these trees were two others of the same kind, actually in the high road ; they were about 30 inches in diameter, and from the bulging form of their roots had preserved the bole underneath them perfectly ; it had the greasy appearance, on fracture, of that of Dr. Spry's "well," and was of a dark-brown colour approaching to that of chocolate. These trunks fell into many pieces when removed ; they were partly underlaid by trap, but this might have been intruded, and the pure trap abutted against one. Cutting a trench by the side, the bole was seen to be horizontal, and overlaid by eighteen inches of trap. Around them was the black-soil with the trap in scattered patches, and underneath the latter the brown bole.

"About 235 paces from this, in the direction of the Babul tree before mentioned, pieces of palm-wood were scattered about ; and close by runs a nullah which, having been scooped out of the black-soil, has exposed the intertrappean lacustrine limestone below. The black-soil on each side has evidently been continuous."

Observation.—We can hardly help inferring now, I think, (though I thought different formerly) from what Captain Nicolls has stated respecting these fossil trees, that they were coeval with the existence of the lake in which the intertrappean freshwater deposits took place ; that the whole was enveloped in the trap in which they are now found imbedded ; and that the black-soil about them is composed of disintegrated trap.

Intertrappean Lacustrine Limestone of Saugor.

From the specimens of limestone from the intertrappean lacustrine formation at Saugor presented by Captain Nicolls, we learn that it is more or less argillaceous, and therefore in some parts converted into white

chert by heat ; that in other parts it is more pure, and there rendered grey and saccharoid ; that in others it is chalky ; in others forms the chief part of a conglomerate consisting of semi-rounded pieces of red sandstone (with *Physa Prinsepii*), but never with any portions of trap that I have seen. It is always coarse, earthy, and massive, not thin and laminated like the lithographic limestone of the "Oolitic Series" though frequently dendritic. So much does it seem to be a part of the thin limestone formation resting on "red clays" and overlying the sandstone of Bundelkhund close by, that Captain Coulthard expressed the hope that its continuity might one day be established. As yet I have never seen a specimen of *Unio Deccanensis* from Saugor.

Limestone attached to the Fossil Bones of Narrainpoor.

As there is a marked difference between the fossilization of the bones in the valley of the Nerbudda and those of Narrainpoor, from the latter having had their cancellated structure filled with agatoid silicious infiltration and the former chiefly with calc spar, while both from their large size appear to belong to mammals of the same epoch, I thought it would be interesting to examine the concretionary limestone attached to the latter, and, taking portions from the canals of the large vertebrae (presented by Captain Nicolls) for this purpose, I found it to be earthy, dendritic in the mass, more or less compact, of a whitish yellow colour, and infiltrated with agate like the bones to which it was attached. It differs from the earthy portions of the intertrappean lacustrine formation about Saugor in being harsher to the feel, less argillaceous, less white, and not so chalky, while it more nearly approaches in general character the modern concretionary limestone called "Kunker" ; at the same time it is by no means identical with the latter. Perhaps it is of intermediate age between the former and the latter, while it is again modified to a certain extent by agatoid infiltration ; but all three having been formed probably in a similar manner, it would apparently be in vain to search for mineral characters by which the specimens of either may always be distinguished.

Ossiferous Conglomerate.

From Captain Nicolls' notes, confirmed by his specimens, the following additional information is abstracted respecting the ossiferous conglomerate of the valley of the Nerbudda. Commencing from Burman Ghât, which is situated on the north bank of the river Nerbudda, about seventy-four miles south of Saugor and fourteen from Nursing-pore, he states, that immediately below the town is a bank of conglo-

merate 80 feet thick by measurement; it is coarse below, and fines upward into a friable sandy deposit; throughout it is more or less infiltrated with calcareous matter, and the base of this scarp being concealed by detritus, the utmost extent of the formation downwards could not be determined. At the depth of 80 feet, Captain N. found the cranium of an elephant, tooth of a horse (?), and bones of an animal larger than a camel, together with shells of univalves and bivalves now existing in the locality, viz. two species of *Unio*, one, the larger common (?) thin species of India, and the other about half the size and thicker, which Captain N. informs me has been pronounced by Mr. J. de C. Sowerby to be *U. cæruleus*; a *Cyrena*, also stated by the same authority to be *C. cor*; *Paludina* and *Melania*. All these shells, though they are more or less filled with calc spar where not penetrated by the conglomerate, are white and but barely of sufficient consistence to hold together, in fact in much the same state as the bones would be but for their originally more compact structure. In the dry bed of a stream opposite to Burman Ghât, on the south bank of the river, Captain N. found tusks of different elephants, as well as their crania, and those of hippopotamus, buffalo, and deer; the conglomerate bank here is only 30 feet high. Further up the river on the same side, about a mile from Burman Ghât, or a little above the Pandoo Khond Islands is the village of Khan Ghât, and between this and a large Gowlee's village, a little further on upon the northern bank of the river, Captain N. found several bovine crania. About four miles and a half from Burman Ghât, still further up on the south side, is Subonee Ghât, close to and on the eastern side of which the Omer Nudi enters the Nerbudda, in the banks of which both Dr. Spilsbury and Captain Nicolls found many fossil bones, partly in the coarse and partly in the fine deposits of the ossiferous conglomerate. But it is beyond this again, viz. between the place last mentioned and Jubbalpoor, and between the latter and Mundela, which has been unexplored, that Captain N. considers the most interesting part of this locality, and that which will probably afford most fossil remains.—Although the cancellated structure of the fossil bones from the conglomerate in the valley of the Nerbudda, which were presented by Captain Nicolls, is chiefly filled with calc spar, they are of three kinds, viz. dark-brown, compact; grey, infiltrated with calc spar; and white, cretaceous; together with compact argillized wood, like that of Perim Island. The compact, dark-brown bones correspond with those of Perim Island; where there are also two kinds, viz. light and dark-brown, the depth of colour merely depending on the quantity of oxide of iron in the calc spar with which the Haversian canals and

cavities of the cancellated structure are filled ; but I have never seen any bones from Perim Island, not even the tusks of the elephants, in a cretaceous state, as they are at Burman Ghât; perhaps it is position, &c., and not time, that we are to look to for an explanation of this diversity.

On the other hand, the bones sent from Narrainpoor, to which I have above alluded, and which come from the water-shed apparently of the Sonar, a tributary of the Ken river, (at a point where the sandstone and limestone of Bundelkhund meet the trappean and intertrappean lacustrine limestone formations of Malwa, according to Captain Franklin's Map, As. Research. vol. xviii.), are all silicified, infiltrated with silex, and the fossil-wood equally hard. "Argillized" would perhaps better designate the state of the fossil-wood both in the conglomerates of the Nerbudda and Perim Island, than "silicified" : for though compact it yields to the knife and breaks with a rough uneven fracture, which is quite different to the impression conveyed by the latter term ; some of the specimens from Perim are also partially black and carboniferous. The greater part of the wood, too, in the intertrappean strata of the Island of Bombay, which have now been classed with the Eocene formations is, though still more or less black and carboniferous, almost entirely argillized and for the most part sectile : so that there is not much difference between the states of the wood in these two deposits.

On the existence of "trap pebbles" in the ossiferous conglomerate, Dr. Malcolmson states that he observed them in it at the Island of Perim as well as in the "cornelian conglomerate" of the Rajpipla Hills ; but Dr. Lush expressly excepts them in the conglomerate of Perim Island and the coast of Khattywar.

I cannot find a trace of trap pebbles in any of the portions of this conglomerate (which are attached to the fossil bones from Perim Island) that are in the museum of the Asiatic Society of Bombay, and these are very numerous ; but in the portions attached to the fossil-bones from the upper part of the Nerbudda at Burman Ghât, which were presented by Captain Nicolls, trap pebbles of the kind I have called "trappite" are unmistakeable.

*Neocqmien Fossils from Bagh and its neighbourhood presented by
Lieut. R. H. KEATINGE, Bombay Artillery.*

Passing down the river Nerbudda and leaving the trap-plateau of Malwan, we come, according to Captain Dangerfield's geological map, almost immediately upon the town of Bagh, which is situated about 22 miles from the Nerbudda and nearly due north of Chiculda ; about 145 miles from the sea and about 850 feet above its level.

At p. 237 of this Volume it will be seen that I inferred the existence of a "coralline limestone" here, and, after giving a description of it, concluded with the following paragraph :—

" It is at Bagh, then, that quarries of this limestone appear to exist, and it seems more connected with the Oolitic Series than any other formation. I place its description here for the present, merely adding, that I think it deserving of further examination on account of its peculiarities, and the probability of its yielding fossils which might determine its geological age."

Fortunately this has now been done; for Lieut. R. H. Keatinge, in company with Mr. J. H. Blackwell, the Government Mineral-Viewer, having visited Bagh and its neighbourhood a few months since in quest of iron-ore, found at the cave-temples and in the neighbourhood of this town the following fossils *in situ*, which reached the Society from Captain Keatinge in the month of April last :—

Ammonites. (A fragment).

Brachiopoda. *Rhynchonella*, Fischer.

Pectinidae. *Janira*, Schumacher.

Echinoidea. *Toxaster* Ag. and *Nucleolites*, (*ano in sulcum*). Lam.

Of these the fragment of ammonite is useless as regard specific distinction, but the *Rhynchonella* is so like *R. sulcata* given by d'Orbigny as a characteristic fossil of the Neocomien age, that but for being a little more numerously plicated it would be the same.* The *Janira* very like *J. atava* given also as a characteristic fossil of this formation;† this genus again, according to d'Orbigny, does not appear before the Neocomien age. *Toxaster* and *Nucleolites* not only do not appear before this epoch, but have their maximum development in it. So that these few fossils determine the existence of Neocomien deposits at Bagh.

But what is particularly interesting here is the correspondence of the specimens of *Janira* with those which I found on the south-east coast of Arabia, and which, as I had none from thence with the flat upper valve, left me in doubt as to the genus of the Pectinidae to which they belonged. The moment however that I saw those from Bagh, both the nature and identity of the Arabian fossils were revealed. In the second edition of my memoir on the geology of the south-east coast of Arabia I thought these lower valves must belong to *Plagiotoma*, but at the same time I likened them strongly to *Janira*, which the Bagh fossils have proved them to be.

* Cours. Elementaire de Paleon. et Gool. Strat. v. ii. p. 602.

† *Idem*, p. 601.

‡ " Geol. Papers on Western India," p. 607 (of which see a notice hereafter).

For the sake of comparison with Bagh, I give the following general section of the scarped face of the south-east coast of Arabia :—

White limestone.....	2,000 ? feet.
Red argillaceous shales and coloured limestones.	1,000 ? ,,
Sandstone	1,700 ? ,,

It is among the argillaceous shales, &c., which are of all colours, though chiefly red, that several species of *Janira* exist as well as Ammonites, and Echinoidea of the genera *Discoidea*, *Pygaster*, *Diadema* and *Salenia*, together with *Exogyra*, an oyster like *O Marshii*, and myriads of *Orbitolina* d'Orbig., plainly pointing out that this part belongs at least to the Cretaceous Period.

The strata at the caves of Bagh, I learn from Mr. Blackwell and Dr. Impey,* consist of :—

Red argillaceous limestones and clay-strata.....	15—20 feet.
Sandstone	100 ,,

It is here again among the red strata that the fossils sent by Captain Keatinge were found; and I learn from Mr. Blackwell's specimens that the limestones are of different degrees of purity and hardness, viz. compact blue and red, breaking with rough fracture; red and yellow coralline,—that to which I have already alluded; fine, soft, argillaceous, of red and yellowish-greenish white colours; while below all lies a stratum of "white clay-stone in places full 20 feet in depth" according to Dr. Impey, after which comes white sandstone: this is the colour of the sandstone shown me by Mr. Blackwell; but Dr. Impey also states that in some parts it is "as dark as copper, in others slightly reddish, which is the hardest and finest variety, and lies superior to the pure white" (*loc. cit.*) ; again Mr. Blackwell adds that it is conformable to the argillaceous series. Hence it is very evident that the upper member consists of variously coloured, but chiefly red, clays, shales, and limestones of different degrees of purity, gradually passing into the lower member, which consists below of pure white sandstone.

On comparing, therefore, the fossils and the strata in which they are found at Bagh and its neighbourhood, with those on the south-east coast of Arabia, we can come to no other conclusion than I see, than that part, at least, of the coloured strata in both localities belong to the Neocondien division of the Cretaceous Period.

I would also add here, that there is a remarkable similarity, if not an identity, between Mr. Blackwell's specimens of limestone from

* Description of the Caves of Bagh, p. 546 of this Number.

Bagh and those from Tendukera about 60 miles below Jubbalpoor, among which this gentleman has also found a rich development of argillaceous iron-ore mixed with limestone. The coloured strata on the south-east coast of Arabia are also characterised by their ferruginous nature, so that at all three places we get similar limestones and similar developments of iron-ore, with the same kind of fossils in two, viz. at Bagh and on the south-east coast of Arabia.

*Discovery of Nummulitic Limestone in the Rajpipla Hills, by
the late Major G. FULLJAMES, Bombay Army.*

Passing still further down the Nerbudda we come to the Rajpipla hills not far from Broach, among which is situated the village of Wasna, which is about 55 miles below Bagh and the locality of Major Fulljames's nummulitic limestone.

It will be observed at p. 249 of this volume* that when I last alluded to this limestone I had only made out the existence of *Orbitoides Prattii* in it, and therefore had not satisfactorily proved that it belonged to the Eocene era; but in publishing another edition of my "Summary"† I have had to re-examine it, and have found two distinct species, of which the following are descriptions:—

Nummulites (Ramondi, mihi). Discoidal, thick; margin angular, acute, slightly wavy. Surfaces smooth, marked with lines for the most part simple, radiating from the centre to the circumference. Spire very regular, consisting of nine whorls; chambers also very regular, a little longer than broad, reflected; septa slightly curved. Diameter $\frac{1}{4}$ inch, thickness $\frac{1}{8}$ inch.—Loc. Wasna in the Rajpipla Hills near Broach. In red and yellow, compact, earthy, argillaceous limestone.

Obs.—This beautiful little nummulite closely resembles *N. Ramondi*, Def., (Foss. Num. de l'Inde, pl. vii. fig. 13).‡ It is associated with *Operculina*, *Orbitoides dispansa*, and small shells. From being imbedded in a ferruginous rock, the parts which contained animal matter have become red, while the rest remains white, hence its beautiful appearance. Having had to examine it by sections, I have observed that the parts covered with and permeated by that substance which I have likened to the "cuticle of shells," (but which the Authors of the work just mentioned more properly liken to the epidermis of *Echinoidea* and the epitheca of polypes), are infiltrated with red oxide of iron;

* Summary of the Geology of India. † Geological Papers on Western India.

‡ As the authors of this work (MM. le Vicomte d'Archiac and J. Haime) have taken notice of some of my geological papers, which have been published in this Journal, I shall take this opportunity of answering some of their remarks.

interseptal spaces white, but the interseptal vessels or canals red ; the marginal cord white, but presenting in its transverse section red points indicative of the position of the marginal canals ; and the external surface of the marginal cord traversed by longitudinal lines indicative of the previous existence of spiculæ such as I have described in *Operculina Arabica* (Ann. and Mag. Nat. Hist. vol. x. p. 161, 1852).

Independently of the Authors of the *Foss. de l'Inde* stating, p. 54, "Or, nous nous sommes assurés, par des observations très-multipliées, que dans aucune des espèces de ce dernier genre [Nummulites] il n'existe rien qui puisse rappeler la corde spiculaire ni le plexus marginal signalés par M. Carter dans l'*Operculine d'Arabie*."—I have had here the opportunity of comparing an *Operculina*, closely allied to *O. Arabica*, which happens to be imbedded with this nummulite, and precisely in the same condition as regards ferruginous infiltration ; and on the surface of the marginal cord of the *Operculina* are beautifully shown the longitudinal lines indicative of the presence of spiculæ, which, when placed side by side with the nummulitic, only exhibit the difference that they are a little more faintly marked in the latter. Both these fossils are most favourably circumstanced for exhibiting the points mentioned ; they are hard but in a comparatively soft matrix, which renders their extrication easy without scratching, so that they fall out with shining surfaces ; both are beautifully regular in structure ; and the contrast between the red infiltrated parts and the crystalline white ones enables the observer to distinguish the limits of the two in each, with the greatest nicety. No one can witness these fossils in comparison with recent *Operculina*, without feeling convinced that the red parts in the former and the green ones in the latter were formerly occupied by sarcodes, and that the sarcodes permeated the walls of the chambers and formed a soft substance on the surface, any more than that the spicular cord existed in all three, as represented by that ridged surface shown so distinctly in Dr. Carpenter's figure of *N. levigata*, 7 c, pl. iv. Quart. Jl. Geol. Soc. vol. vi. ; and with the openings of canals from the marginal plexus, in MM. d'Archiac and J. Haime's fig. *b. e.* of the same nummulite, pl. iv. *Op. cit.*

I have also lately noticed, that in some specimens of *Operculina Arabica*, the spicular structure is not only present on the margin, but is extended inwards over the interseptal spaces between the last five or six chambers.

Nummulites Broachensis, n. s. c. (*nov. sp.?*) Discoidal, thick ; margin angular acute. Surface smooth, presenting punctæ arranged spirally, without striae. Spire regular, consisting of six whorls ; cham-

bers longer than broad, septa reflected, curved. Diameter $\frac{4}{5}$ inch, thickness $\frac{1}{2}$ inch. *Loc. idem.*

Obs.—At first I thought all the little nummulites in this argillaceous limestone were the same, but the former evidently belongs to the *Plicatæ et striatæ*, and the latter to the *Punctulatæ*, (d'Archiac et Haime); and answering to none of their species, from the spiral arrangement of the punctæ being without striae, I have taken the advantage of giving it the above specific designation, to record the fact of the existence of Eocene Strata near the town of Broach, about fifty miles up the river Nerbudda.

Thus we see that at Bagh we have Neocomien strata; lower down the Nerbudda, deposits of the nummulitic age; and at the mouth of the river, viz. at Perim Island, as well as along its course, the Ossiferous Conglomerate; showing that along its valley it presents the same formations successively as the Ganges and Indus. May we not look for a similar set of deposits towards the debouchements of the other great rivers of India, viz. the Godavery, Cauvery, &c.?

Discovery of beds of Lignite under the Laterite at Rutnagherry.

By Dr. de Crespigny, Assistant Surgeon H. C. S., Bombay.

I have just suggested the existence of deposits from the Neocomien Age downwards, along the lower parts of all the great rivers of India, and the following suggests, as far as the Eocene Era goes, deposits at least of this epoch all round its shores. Rutnagherry, the place at which these beds of lignite have been found, is situated on the western coast of India, about 120 miles south of Bombay. In briefly describing them, Dr. de Crespigny, to whom we are indebted for this important addition to our knowledge of the intertrappean formations, states, in his note dated the 16th July 1856, that in a quarry near Rutnagherry, where he is residing, beds of lignite are found, and that "1,000 yards further inland a well was sunk through the laterite, which gave the following section:—

" Soil and detrital conglomerate, a few feet.	
Laterite (soft below)	35 feet.
Compact iron-stone	1 $\frac{1}{2}$ "
Lignite }	27 ;
Blue clay }	
Water, yellow gravel.	
Trap."	

As the existence of these strata was casually noticed by Dr. de Cres-

pigny and I did not see his observations until the rains had commenced, he had not the means, when I wrote to him on the subject, of sending me more than the above section with specimens, but he will resume his researches as soon as the subsidence of the water in the quarries and wells about Rutnagherry takes place; meanwhile there is sufficient in this section and the specimens to attach great interest to the subject.

In his note, he further observes—"The lignite underlies the solid laterite, which Voysey and you declare to be of volcanic origin." This is his reply to the question whether it was a laterite of detritus, or what I have termed genuine laterite, viz. that which contains no foreign material and appears to be a mere decomposition of trap or basalt; because if this 35 feet of laterite be the remains of a trappian effusion, then these strata, so far as this goes, are most assuredly similarly situated to the intertrappean lacustrine strata, of the Island of Bombay, at least.

But to return to the specimens. I learn from these that this formation consists above of an argillaceous, gravelly deposit, speckled white and grey, in which are imbedded black lignite, mineral resin, and pyrites, and below this, fine blue plastic clay; all of which are identical with the lignite, mineral resin, pyrites, and blue clay of the beds which underlie the detrital laterite on the coast of Travancore; but the speckled argillaceous deposit, in which the lignite is imbedded, most strikingly resembles much of the intertrappean lacustrine strata of Bombay, among which wood also exists, not exactly in the state of lignite, but argillized and slightly coal-bearing; that of the Rutnagherry strata also frequently approaches the former state, in being more or less earthy, soft, and sectile; while the difference in the presence of coal may be owing to exposure to a greater degree of heat as will be more particularly mentioned hereafter.

No shells have yet been found, so that whether these deposits took place in salt or in fresh-water is not yet known; but the pieces of lignite are much rounded by attrition, and there are carrels and seeds apparently of some large tree, among the specimens, so perfect, that if the forms of the vegetable remains generally be so well preserved as these, there will not be much difficulty in determining the *Flora* of this deposit. To its probable geological age, as well as that of the Bombay strata and those near Rajamundry, we shall come by-and-by. I also noticed among the lignite, round warty-looking pieces like those so common in the Bombay strata, and which I at first supposed to be

fungoid excrescences, but which subsequently were proved to be what I have termed them, from having been found *in situ* imbedded in the bark in which they grew.

Description des Animaux Fossiles du Groupe Nummulitique de l'Inde, précédée d'un Résumé Géologique et d'une Monographie des Nummulites, par le Vicomte d'Archiac et Jules Haime.
Large 4to. 32 Plates. Paris, 1853.

It is right that notice should be taken here of this work, not so much for answering certain remarks in it on matter which has appeared in this Journal, but for the purpose of commending it to the student of Indian Geology. Written by men of the highest proficiency in Geology, Geography, and Natural History, on a group of fossils (viz. the Nummulites) at once of extreme interest and before in almost inextricable descriptive confusion ; especially devoted to Sind and its fossil remains generally ; it becomes not only an indispensable work to the student of Geology in India but to the Geologist throughout the world. The materials from Sind, as will be seen by the "Preface," were chiefly supplied by the Geological Society of London, and the work written by Authors, one of whom is the distinguished Secretary of the Geological Society of Paris.

To state what the work contains is much easier than to review it, and this is best done perhaps by observing, that the first part is devoted to the Nummulites generally, and the second to the other fossils of the Nummulitic Formation in Sind, especially. It abounds in references, and lithographic illustrations of the finest kind, the accuracy of which again, in delineation, is guaranteed by the indubitable correctness, acumen, and judgment of the Authors.

Amongst the remarks made on papers published in this Journal, I shall only allude to two here, viz. that on the grouping of the Eocene and Miocene strata in my Summary of the Geology of India,* and that on the identity of *Orbitoides Mantelli*, d'Orb., with *Orbitolites Mantelli*, H. J. C.;† which, with the rest, I have already endeavoured to answer in the reprint of "Geological Papers on Western India, &c." before mentioned ; but as the "Note"‡ in answer to the remark on the Eocene and Miocene strata equally refers to corresponding parts in this volume (*loc. cit.*) I shall here reprint it entire.

It might appear that I have servilely followed the arrangement

* This volume, pp. 248 et 292 respectively.

† *Idem*, p. 138.

‡ *Geol. Pap. Western India*, p. 743.

proposed by the Vicomte d'Archiac and M. J. Haime, but a perusal of the second edition of my Geology of the South-east coast of Arabia in the work just mentioned will show that I was compelled to it independently of their valuable suggestion. The following is the "Note" to which I have alluded :—

" To those who have read both editions of the foregoing ' Memoir' on the Geology of the south-east coast of Arabia, the necessity of grouping the strata under the head of Miocene in the first edition with the Eocene strata in the second edition, will have been obvious ; at the same time it will be seen, that if this has been done on the coast of Arabia, it must be done on the western coast of India, for the grounds on which a similar series was established on the latter were based upon its assumed existence on the former. .

" That this should be the case receives further confirmation from the observations of the authors of the ' Fossiles du Groupe Nummulitique de l'Inde,' p. 358, who, in commenting on this part of my ' Summary,' observe, respecting the Miocene Group :—L'ensemble des formes ne prouve pas qu'ils appartiennent à cette période, et jusqu'à une démonstration complète, nous les regarderons comme faisant partie de la formation inférieure. * * * Nous sommes d'autant plus conformé dans cette conclusion, que nous avons observé des Nummulites dans les échantillons d'espèces placées, par M. Grant comme par M. Carter, dans les couches de Cutch qui n'en renferment pas (*Ostrea vesicularis*, *Natica angulifera*, *Solarium affine*, *Voluta jugosa*, *Terebellum obtusum*, etc.). Nous continuons par conséquent à ne commencer ici la formation tertiaire moyenne qu'avec les couches inférieures à ossements de grands mammifères.

" We shall now do the same, but before making this change let us see what additional information respecting these formations on the western coast of India has been obtained since my ' Summary' was compiled.

" In the first place, it will have been seen by the foot-note, p. 696 *et seq.*, that the supposed nummulitic limestone from the neighbourhood of Broach on the river Nerbudda is undoubtedly of the Eocene era.

" Secondly, the great number and forms of the different species of *Cerithia* in the limestone from ' Bate Island,' at the north-western extremity of Khattywar, also unmistakeably prove that this is of the same period ; though the deposit was littoral, for it is not only arenaceous and argillaceous, but there is much fossilized wood among the shells.

" Further down on the outer coast of Khattywar again, is the compact, yellowish limestone made known to me through specimens brought by

Lieutenant Constable, I.N., which, in addition to the characteristic *Strombus* (*S. Fortisi*, Al. Brong.?)—*Foss. Num. de l'Inde*, pl. xxx. fig. 17) of these formations on this coast, and other shells of Eocene form, is richly charged with *Orbitolites*, Lamarck; in which it resembles the orbitiferous Eocene rock close to Ras Sajar on the south-east coast of Arabia (p. 599, *ante.*).

"Here, however, there is but one species of orbitolite, which in its largest size is $\frac{1}{4}$ inch in diameter and about $\frac{1}{8}$ inch thick at the circumference; the centre being a little thinner chiefly because the cells are smaller, but the whole appears to be composed of a horizontal inclined plane twisting round a vertical axis, and thus would resemble a deep-cut screw so compressed longitudinally that the whorls were made to touch each other; but with the uppermost and undermost layers united at the margin and enclosing all the rest like the last whorl of a nummulite; indeed this spire is sometimes twisted round a central cell too, like that of a nummulite. The layers thus arranged are composed of lines of cells increasing slightly in size with their distance from the centre, from which they take a spiral course to terminate at the circumference. In this structure it will be seen that they resemble *Orbitolites Malabarica*, H. J. C. (*Ann. and Mag. Nat. Hist.* v. ii. p. 425, 1853), of the blue, clayey, argillaceous limestone of the coast of Travancore, but the cells are much smaller, and the structure throughout finer and more compact, so that they more nearly approach *Cyclolina*, in the centre of which, as well as in *Orbitolites*, Lamarck, I have seen the same spiral arrangement.

"There can be no difficulty then in assigning this rock to the Eocene period.

"Lastly comes the argillaceous limestone of the Malabar Coast (to which I have just alluded), not only abundantly charged with the *Orbitolites Malabarica*, but here again in company with *Strombus Fortisi*, together with *Cerithium rude*, *Ranella Bufo*, *Cassis sculpta*, *Voluta jugosa*, *Conus catenulatus*, and *C. marginatus* (Grant, *Geol. Cutch. Tert. Foss.*); also *Natica*, *Turbo*, *Pleurotoma*, *Fascicolaria*, *Murex*, *Cancularia*, *Ancillaria*, and *Cyprea*, all (new species?) closely allied in form to the figured shells of the Eocene period. The orbitolite differs very little, except in size, from *Orbiculina angulata*, Lam. (*Encyclop. Méthodique*, pl. 468, fig. 3), from which I infer that the latter should also be included among the *Orbitolites* of the same Author.

"There can be no objection, therefore, to considering this formation also a part of the Eocene deposits, and we have now only left the

blue clay, of which the foregoing limestone and shells being only a part, this, as a matter of course throughout the western coast of India, falls into the same category.

" Not only is lignite seen in the blue clay of Travancore, but portions of it exist also in the argillaceous limestone, as we have seen fossil-wood among the shells of the Eocene limestone of 'Bate Island.' Gyrogonites, or seeds of Characeæ, abound in the blue clay of Kurrachee with lignite; and 'Charoideæ,' we find, from Captain Vicary's statements, partly characterise the upper division of his nummulitic deposits in Sind. Gyrogonites are common in the Parisian strata, which again are equivalent to the London clay, in which are found nummulites. So that everything tends to the view taken of these formations by the Authors of the Foss. Num. de l'Inde, viz. that they should be included in the Eocene period and the next division commenced, from below, with the Ossiferous Conglomerates.

" The question now, however, which presents itself is, what are we to do with the Rutnagherry deposits, which underlie lateritij, and are identical, in containing similar lignite and resin, together with blue clay, with the deposits on the coast of Travancore, now evidently belonging to the Eocene era? This seems to me not to require a moment's consideration, inasmuch as the identity, in the absence of characteristic organic remains in the latter, is sufficient to combine the two, particularly when viewed with relation to the lacustrine strata of the Island of Bombay, which, from containing the remains of batrachian* reptiles (viz. frogs), whose first appearance in a fossil state, according to d'Orbigny, did not take place until towards the middle of the tertiary period or upper part of the Parisian series, brings all these formations on the western coast of India into the Eocene group of Sir Charles Lyell.

" (Does not the capping of these deposits with black basalt at Bombay, and wth 'genuine laterite'—that is, laterite which contains nothing but what might come from a trappean effusion—which 'is at Rutnagherry, show, that one is but another form of the other; more especially when we see a part of the top of the basalt at Bombay, close to Worlee flagstaff, passing into laterite; and does not the shining coaly state of the lignite in the strata at the former site, compared with its dull earthy black aspect at the latter and at Travancore, point out that the difference has been occasioned by the greater heat of the molten matter that overflowed them in Bombay, thus producing a more durable condition of the effusion here than at Rutnagherry? In short, is it not the more thoroughly molten state of the former which has enabled it

to withstand the destructive agency of time, and the less molten state of the latter which has allowed it to pass into laterite?)

"What now, then, is to become of our intertrappean lacustrine formation of the Deccan? The basalt under which it lies in the Gwailgurh Hills being, according to Voysey, the same as that of the 'Pouce' in the Mauritius, is the brown old basaltic effusion of the Deccan, and not the fresh, deep, black purple one of Bombay; and who, looking at the general appearance of *Unio Deccanensis*, with its thick heavy shell converted into compact material of a deep leaden hue like that of the fossils of the Jurassic period, compared with the white *Helix* and *Lymnea* of the European Eocene, which would seem to have their types in a formation of similar age close to Cape Comorin (Specs. in Mus. Bom. As. Soc. presented by Major General Cullen), would not instantly conclude that the formations from which these fossils came could not be of the same epoch, and that the compact blue *Unio* must belong to a much older one than the white, almost pulverulent, *Helix* and *Lymnea*?"

However, we must not be guided altogether by appearances in this matter, for since the foregoing paragraph was written, I have observed, that the Rev. Messrs. Hislop and Hunter have determined the existence of *Physa Prinsepia* among the marine fossils of the infra-trappean deposit at the lower part of the Godaverry near Rajamundry* which *a priori* one would conceive to be Eocene like that of the western coast of India, but as yet its geological age has not been ascertained. Again a specimen of *Unio Deccanensis* lately presented to the Society by the Rev. Mr. Hislop is quite white, not "blue," and the specimens of *Physa Prinsepia* from Saugor presented by Captain Nicolls are for the most part as white and pulverulent as the *Helix* and *Lymnea* of the Tertiary Formations, while both Mr. Hislop and Dr. Bradley inform me that the *Unio* and *Physa* are found together; so that what I have stated above goes for nothing so far as the geological age of these fossils is concerned.

In connection with this subject I should not omit to notice, that the variety in form is as great as the variety in fossilization of *Unio Deccanensis*; some specimens being oblong and others almost triangular, while the latter are more or less plicated and the former sometimes hardly at all so; the shell also varies greatly in thickness; but when several specimens are brought together, all the varieties can be so traced into each other, that those of the most opposite kind, viz. the oblong and triangular forms, fail to maintain that specific difference among a great number which seemed to be so decided when viewed by themselves.

* Quart. Jl. Geol. Soc. Lond. vol. xi. p. 365.

Orbitolites Mantelli, H. J. C.

With reference to the remark of the authors of the Foss. Num. e l'Inde placed opposite "Orbitolites Mantelli, Cart." in their "Table" p. 363, viz. "Est-ce bien l'espèce des Etats-Unis?" I can only observe, that it agrees strictly with the characters of "Orbitoides Mantelli" given by Dr. Carpenter in the Quarterly Journal of the Geological Society of London (vol. vi. pl. vi. figs. 20, 21, and l. vii. fig. 31) viz. in presenting, on a horizontal section of the central lane, *circular cells* having apparently a "concentric" (p. 32, *id.*) arrangement; and in a vertical section quadrangular cells in the central lane, and compressed cells above and below it, hence the cells of the central plane must be cylindricical, while the variety of shapes which this fossil may assume, from the variable thickness of the mass of compressed cells, gives it at one time a plane and at another a raised surface in the centre. These characters are also presented by the other specimen which I have described and figured (Ann. and Mag. Nat. Hist. vol. xi. p. 175, and pl. vii. figs. 40 and 41, respectively), and which the authors to whom I have above alluded have conjectured to be *Orbitoides* (p. 350, *op. cit.*). But how can either of these species be *Orbitoides*, when the central plane of this fossil is composed of *oblong* chambers, arranged in *subspiral* lines running off from a centre, with their *long axes horizontally*?—unless the opposite to these characters be deemed insufficient for a generic distinction, and a "considerable" elevation of the disc "diminishing gradually towards its margin," as Dr. Carpenter has remarked in his "Monograph on the Genus *Orbitolites*" (Philosophical Transactions, 1856, p. 195), be regarded as decisive. Still this will not be sufficient, for many varieties of this fossil do not present any elevation at all, being perfectly flat and square at the ends in a vertical section, like some of the fossils to which Dr. Carpenter has rightly restricted the term *Orbitolites*. At the same time the fossils which I have described under the head of "*Orbitolites*" are so distinct from those described under that of "*Orbitoides*" (Ann. and Mag. Nat. Hist. *loc. cit.*), that I cannot see how the two are to be included in the same genus. The respective characters of the central planes of *Orbitoides* and *Orbitolites* are given in figs. 35 and 36, pl. vii. (*Id.*; *id.*), and the other differences mentioned in the text.

I am by no means certain that the cells of which the central portion of *Orbitolites Mantelli* H. J. C. is composed have a concentric arrangement, and if this should not be the case, but they come off sub-

spirally, as the chambers of the central plane of *Orbitoides*, then it seems to me not improbable that these subspiral rows of cells may issue from a spiral line twisted round the vertical axis of the fossil, after the manner of the rows of cells in *Orbitolites Malabarica*, H. J. C. (Ann. Mag. Nat. Hist. vol. 2, p. 425, 1835), which I now find to be so closely allied in structure to *Orbiculina angulata*, Lam. (Tab. Encyclopéd. et Méthod. t. iii. pl. 468, fig. 3), that its place seems to be under this genus rather than *Orbitolites*, Lam. #25,—1856; but *Orbiculina pleurocentralis*, H. J. C.,* has no marginal pores any more than Lamarck's *O. adunca* (*loc. cit.*), while his *Orbitolites*, which Dr. Carpenter has very properly taken as the type of this genus, has ;—so here again adjustment seems necessary.†

* The following description of this fossil, which was found in company with *Orbitoides Mantelli*, d'Orb., is extracted from the "Geological Papers on Western India," p. 593 :—

" *Orbiculina pleurocentralis*, H. J. C. (*nov. sp.?*) Elliptical, thin, flat, wavy. Surface presenting a corresponding prominence on each side, situated laterally and towards one end of the ellipse, covered with minute tubercles, which, becoming larger excentrically, pass off into moniliform rows, that, after a subspiral course, terminate on the margin. Internally consisting of a single plane of oblong chambers filling up the intervals between the rows of tubercles, with their long axes horizontal and across their spiral course. Margin inflated, round, smooth, without apertures. Length of largest specimen 7-24ths inch, breadth 5-24ths inch, thickness at the prominence a little more than at the margin, which is 1-60th inch. Loc.—Takah, SE. coast of Arabia.

" Obs.—This beautiful little pearl-white fossil abounds among the *Orbitoides* and *Orbitolites* just mentioned. It bears the same relation in point of simplicity of structure to *Orbitoides* that *Operculina* bears to *Nummulina*. It also closely resembles, in the section and contour, fig. 2 c of Lamarck's *Orbiculina adunca* (Tabl. Encyclopéd. et Method. pl. 468). Should we choose to assimilate this fossil to *Operculina*, we have only to draw an *Operculina* with three or four whorls and reflected chambers on a piece of paper, and then join the septal divisions of each whorl together and strengthen these lines while we lighten that of the spire; the spire dividing the whorls will then represent the septa in *Orbiculina*, and the septa being joined end to end in *Operculina*, will represent the lines of tubercles in *Orbiculina*.—A vertical section through the long axis of this fossil shows that the short part, behind the prominence, is thin at the margin, while the margin of the long part, or that in front of the prominence, is inflated."

† Since the above was written I have received Dr. Carpenter's second valuable "Memoir" on the Foraminifera (Phil. Trans. p. 547, 1856), by which I observe that all this adjustment has been made. *Orbitolites Malabarica* and the *Orbitolites* of Khattywar (p. 630) should now come under the term of "*Orbiculina*" respectively; and *Orbiculina pleurocentralis* under that of "*Heterostegina*," d'Orbig. But *Orbitolites Mantelli* H. J. C. is still unprovided with a proper name, inasmuch as it is neither *Orbitolites*, Lam., nor of the type of *Orbitoides Pratti*.

Hence then, if the structure of *O. Malabarica* should be the same as that of the centre of *Orbitolites Mantelli*, H. J. C., we should have *O. Malabarica* bearing a similar relation to *Orbitolites Mantelli*, H. J. C., that the *Orbiculina* described (p. 634) bears to the central plane of *Orbitoides*, and *Operculina* to that of *Nummulina*; but the arrangement of the cells, forming the centre of *Orbitolites Mantelli*, H. J. C., has yet to be discovered; it evidently consists of a plurality, but whether they come off spirally from a vertical axis or not, I have, up to this time, been unable to determine; a concentric arrangement would be more a character of *Orbitolites Lamarck*, than of *Orbitoides d'Orbigny*.

Cyclolina, d'Orbigny, *not confined to the Cretaceous Period.*

With reference to the two species of *Nautili* which chiefly abound in Sind (see p. 254 of this vol.) and to which the Authors of the Foss. Num. de l'Inde allude, I have added a *Foot-note* to the second edition of my "Summary of the Geology of India (*op. cit.* p. 700), not so much to state that they are the same as those described in this work, as to introduce, in connection with them, the fact of the existence of *Cyclolina* during at least part of the Eocene period, and thus to correct an error which I had fallen into through d'Orbigny's having inferred that this fossil was confined to his "Cenomanien" division of the Cretaceous Era. The following is the "Note" to which I allude:—

"The first of these *Nautili* is *N. Deluci*, d'Archiac, pl. xxxv. figs. 2, 2a; and the second *N. Labechei*, d'Arch. et J. Haime, pl. xxxiv. figs. 13, 13a, and pp. 337, 338, *op. cit.* In examining a specimen of the former, I have just had the good fortune to discover that the contents of the last chamber are charged with *Cyclolina* and *Alveolina elliptica*; I state 'good fortune,' for it will have been seen that by following M. Alcide d'Orbigny's 'Tableaux' (Course Element. de Paléont. &c.) I have made it the signal for recognizing the commencement, in the descending order, of the *Cretaceous Series* on the south-east coast of Arabia, whereas it is by no means limited to this period. At first I thought, from the great resemblance of *N. Deluci* to *N. triangularis* of the Cretaceous series, that they might be the same, and that probably the hills about Hyderabad in Sind where I had found *N. Deluci* *in situ*, and had not observed nummulites, might be a part of the cretaceous deposit; but on examining specimens of the limestone charged with *Cyclolina pedunculata* from the Buran river not more than thirty miles from Hyderabad, I find that there are also many small nummulites present very like if not the same with

"*N. latispira*, Menegh. (Foss. de l'Inde, pl. i. fig. 6); while in limestone bearing the same species of *Cyclolina* from other but unknown parts of Sind, there are small nummulites of the group *Punctulæ*. Now, the *Cyclolina* in all being the one mentioned and hardly deserving of a different designation from d'Orbigny's *C. cretacea*, while it has been found throughout the Cretaceous Series on the south-east coast of Arabia, it follows:—1st, that this fossil has, perhaps, the widest range as to time of all the larger species of Foraminifera, and 2nd, that the summit of the great scarp on the South-east coast of Arabia is by no means so evidently confined to the Cretaceous Series as d'Orbigny's range of *Cyclolina* alone had led me to infer."

Geological Papers on Western India, including Cutch, Sind, and the South-east Coast of Arabia, to which is appended a Summary of the Geology of India generally. Edited for the Government by Henry J. Carter, Assistant Surgeon H. C. S., Bombay. Royal 8vo. with an Atlas in 4to. containing 32 Maps and Plates. Bombay, 1857.

Of this compilation, to which I have several times alluded above, more need not be stated than what is contained in the following paragraphs, which have been extracted from the "Preface":—

"The plan adopted in the arrangement of the compilation has been, first to introduce the reader to the Geology of the great Trappean region of Western India, and then to carry him round its outskirts, in order that he might be brought acquainted with the Geological formations of India generally. His attention then is directed to the Geology of Cutch, afterwards to that of Sind, and, lastly, to that of the neighbouring coast of Arabia.

"For this purpose almost all the Geological Papers that have been written on these different parts have been reprinted *in extenso*, by which the reader will not only have the full advantage of the authors' descriptions, but the facts contained in them in their own words. Of the papers which have not been printed entire, chiefly to avoid repetition of what appears in other parts of the volume, abstracts have been made; and of the few which have not been printed at all, whatever they contain worth remembering is embodied in the papers which have been printed *in extenso*. So that with the exception of this matter, altogether only amounting to a few pages, the book comprises all that has been written on the subject, and therefore all that the Geologist of Western India can at present obtain, to lead to future discovery.

"It must not be thought, however, that this compilation embraces

an introduction to Geology ; this the reader must have already acquired before he can even understand its contents ; nor must the Economist expect to find all that information here which he desires, for such detail would be incompatible with the object of the work ; but both will find in it reason based on a geological knowledge of the structure of the earth in India, or, in other words, scientific Indian Geology ; a light which though dim at present, will brighten as it is used, and at length lead to that development of mineral resources which the mere Economist would grope for in the dark, without finding, to the end of time.

" All the papers reprinted *in extenso* are unaltered from their original form, with the exception of those by the Rev. Messrs. Hislop and Hunter, and those by the Editor. The former of which have received several valuable alterations and additions from the Rev. Mr. Hislop ; and the latter have not only been re-cast in many parts, but have undergone as much alteration, addition, and correction throughout as the Editor had time to give them while they have been rapidly passing through the press.

" To the Editor's 'Summary of the Geology of India,' which was included in the Government list, and has therefore been printed at the end of the volume, the Editor has only been able to add 'Foot-notes' suggestive of the future alterations that should be made in it ; being unable to devote that time to a re-arrangement of the whole which such alterations would necessitate.

" Further, that the compilation might be made as useful as possible, not only the maps and plates belonging to most of the papers have been lithographed to accompany them in the form of a separate Atlas, but the Editor has also added an Alphabetical Index for reference to their contents generally."

Encrinitic Limestone from above the Western Ghâts.

Of this interesting specimen, which was presented to the Society by Dr. de Crespigny, the latter states :—" In examining a bag of stones the other day which was found in a lumber-room of the Revenue Survey Establishment here (at Rutnagherry), I found among bits of schiste, lignite, scoriae, quartz of sorts, &c., a piece of what looks like argillaceous limestone (siliceous or metamorphosed) containing fossil impressions of Crinoid Stems (?) ; most of the specimens were labelled from Konkunkoss above the Ghâts."

This specimen I have also examined ; it is of a blue colour, and, if not metamorphised by heat, is so from age and other circumstances, for,

Except where it is weathered, no trace hardly of its fossil-contents can be observed, but, where it has been exposed, there the remains of crinitic stems are unmistakeable, empty or filled with rhomboidal alcspar; and considering the position as to locality and contents where it was found by Dr. de Crespigny, and the specimen being too insignificant a character to conceive that it ever formed part of a cabinet brought from Europe for instruction, there seems to be every reason to conclude that it did come from some part of Western India, and probably with the other specimens so labelled, from "above the Ghâts."

Jurassic Fossils from the Somali Country. Presented by Captain R. F. Burton.

Among a small collection of fossils collected by Captain Burton and his party in the Somali country, are, besides a few Tertiary, the following from the Jurassic Series :—

Belemnites canaliculatus, Schloth. (Grant, Geol. Cutch, pl. xxiii. figs. 2, 3; Trans. Geol. Soc. Lond. vol. v., and pl. xvii. *id.* this vol.)

Terebratula intermedia, Sowerby, (*id.* pl. xxii. fig. 10, and pl. xvi. *id.* this vol.)

T. Microrhyncha, Sowerby, (Colonel Sykes on Fossils of Cutch, pl. lxi. fig. 7, *id.* and pl. xxi. *id.* this vol.)

Besides these there are several other Terebratules, all of which, if not so much weathered, might find their identifications in figs. 13, 15, and 16 of the Cutch fossils (*loc. cit.*)

Arca (*species?*)—Subtrigonal, much elongated posteriorly. Length 2 inches, width 1 inch. Ribbed and marked on the surface like *Cucullaea virgata*, Sow. (pl. xxii. fig. 1, *loc. cit.*), but by no means the same species.

Exogyra auricularia, Goldf. *mihi* (pl. 87, fig. 2). Subsquare, $\frac{1}{2}$ inch broad and long, $\frac{1}{4}$ inch deep. Bearing the impression of part of a Terebratula to which it had been attached.

It is interesting to find that the principal part of these fossils are identical with those of the Jurassic strata in Cutch. Some of the Terebratules, Lieutenant Speke assured me that he picked up a few miles inland, opposite Dunder Ghoree, at a height exceeding 6,000 feet.

ART. XVII.—*On the Transition of Trap into Laterite.* By
Assistant Surgeon F. BROUGHTON, Civil Surgeon, Kolhapoor.

Presented 12th March 1857.

THIS interesting subject has long engaged the attention of geologists, and different theories have been propounded as to the process by which the hard unyielding rocks—basalt and trap, are converted into the easily wrought material—laterite.

2. Having lately enjoyed peculiar opportunities for observation in the extensive lateritic field of Rutnagherry, I am disposed to think that the exact change has not been hitherto perfectly understood.

3. The opinions of Voysey are cited in Mr. Carter's admirable summary, and his description of its origin as by transition through clay is considered the most probable although still doubtful theory.

4. My recent researches in the wells and quarries of Wagotana enable me to corroborate this view, although the presence of another agent, not alluded to by authors, is, I think, requisite for the conversion of the one rock into the other.

5. It will, I trust, become apparent from the evidence I am about to adduce, that the composition of laterite and trap is not truly isometric, so that simple transition is impossible. I believe the presence of water is essential to this action. By its means a sort of double decomposition appears to take place. The trap is resolved into red clay, and the clay in combination with water becomes laterite.

6. We are all, I think, too much accustomed to speak of this and similar geological transitions in the past tense, and to overlook important changes which are carrying on their ceaseless operation within the limits of actual observation.

7. In the numerous sections I had opportunities of examining, I never found the trap and laterite in contact. At whatever depth—30, 40, or 50 feet—a layer of homogenous and intensely red clay invariably intervened, and it was always close to this seam that the springs were found in the wells. This layer is always exceedingly soft until after exposure to the air. Water evidently plays an important part in the

transformation. The intense red colour disappears, and the mass assumes the cancellous structure peculiar to laterite.

8. This relative position being invariable, I must express my inability to understand how (as Mr. Carter supposes) laterite may sometimes be found resting upon non-trappean rock.*

9. I must suppose all laterite to be similarly formed. That which is now seen capping lofty hills must necessarily have been formed from the hill previous to its elevation. In either its primary soft and caseous condition, or its consequent compact form, it seems to be difficult to imagine the capability of its removal from the site upon which it was produced, without such derangement of structure as to render it incapable of recognition.

10. I forward specimens exhibiting this interesting change, premising that Nos. 4 and 5 can never be correctly estimated except in their natural soft condition. They are for demonstrative purposes nearly ruined by exposure.

11. No. 1 is a specimen of trap cut three feet below the laterite, and upwards of thirty feet from the surface. This is as usual firm and compact, and resists any but the most violent means of fracture. No. 2 is trap partially changed and already becoming more fragile, and distant about 18 inches from the laterite. In No. 3 it is seen still more softened, and breaks with little violence under a hammer. No. 4 is the layer of red-coloured clay now hard but always soft *in situ*. No. 5 is the upper layer of clay segregating into laterite and as soft as soap before exposure to the air. No. 6 is the laterite of which the houses and bridges of this part of the country are constructed.

12. Easily cut out in blocks of any size required, it is remarkably fitted for building purposes, and after acquiring hardness by exposure it is exceedingly durable. Works of considerable magnitude have been executed with this most useful rock, which has been for many years quarried in Wajotana. To give an idea of the ease with which it is manipulated, Colonel Scott made piping for an aqueduct with this laterite, the blocks being hollowed out and closely fitting into each other.

13. It will readily be allowed, after examination of these specimens, that the compact material forming the trap No. 1 takes up less space than the same material after its decomposition into clay and re-decomposition into laterite. Considerable expansion must take place, and heat and gas is probably evolved, and the cracked appearance of all hill-tops capped with this rock is thus easily accounted for.

* If trap be an overlying rock, and trap passes into laterite, it is not difficult to conceive how laterite may overlie a "non-trappean rock."—ED.

14. The effect of this expansion is remarkable in this part of the country and bids fair to alter very materially its geography. The rivers are rapidly filling up. Islands are appearing, some even cultivable in situations where, to my own personal knowledge, only eight or nine years since there was sufficient water for boat navigation.

15. On the banks of the streams and rivers more and more ground is annually reclaimed from the tide and brought under cultivation, and revenue is thus on the increase; whilst on the other hand the admirably constructed bunder and quay of Wagotana will probably in a few years be unapproachable by water.

16. This change is not confined to this river, but its neighbour, which sustains the traffic of the city of Rajapoore, is becoming less navigable every year. Formerly country craft could at high-water discharge their cargoes close to the crowded markets of the city, but a transfer to small boats is now necessary.

17. Although a portion of the same trappean range, Kolhapoor, above the Ghâts, is not lateritic. In the month of September in this year the rains had disappeared from this part of the country, but upon getting to the laterite I found there was still a steady monsoon. This I attributed to difference of level, but to my surprise, when returning along the laterite to Belgaum, I carried the rain and clouds with me into that station, which is also lateritic. This is, I believe, always the case; the monsoon invariably continues for a longer period in this region, and suggests the idea of some connexion between these observed phenomena.

18. Does this enormous chemical action going on in the lateritic country exercise an attractive influence, or is the plentiful supply of rain the cause of the lateritic action. I am inclined to the latter opinion. The surface in the neighbourhood of the finest quarries for, laterite is generally cracked and full of holes, so that water readily percolates through the coating. The very extraordinary changes which trap thus undergoes are rendered peculiarly striking during the monsoon. Trap is of course from its structure incapable of supporting vegetation whereas upon laterite considerable crops of grass and singularly beautiful flowers are produced.

19. My object will be accomplished if I have succeeded in showing water to be necessary in this transition; that the laterite now observed capping in mountains must have been formed previous to elevation; and that this singular decomposition is now in full activity and effecting important changes over a considerable area in Western India.

ART. XVIII.—*Abstract of the Proceedings of the Society for the Years 1853-54, 1854-55, and 1855-56.*

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MISCELLANEOUS information connected with the Province of Kutch. 1855	Govt. of Bombay.
OFFICIAL Correspondence relative to the Introduction of a rough Survey and Revenue Settlement in the Province of Sindh. 1855 ..	—————
PHYSICAL Character of the Nerbudda River and Mineral Resources of the Nerbudda Valley. 1855.....	Supreme Govt.
PROCEEDINGS relative to the resumption of certain Villages and Lands held by the late Anajee Nursew, and claimed as hereditary Inam by his son Konker Row Anajee. 1855.	—————
SCOTT (Lieut.-Colonel W.), Report by, on the Management of Canals and Forests in Sindh. 1853.....	Govt. of Bombay.
TYTLER (C. E. F.), Report by, on the Kownaee Talooka, Nassick. 1853.....	—————
WEBSTER, LESTER, and DICKSON (Lieutenants), Reports by, on the Districts lately resumed from Meer Ali Moorad in Sindh. 1853 ..	—————
WINGATE ² and MASON (Captains), Report by, on certain Talookas in the Dharwar Collectorate; also extract of Report by, on the history of the Chikodee District of Belgaum. 1853 ..	—————
WINGATE (Captain), Report by, on the Badamee and Bagulkote Talookas, Belgaum. 1853 ..	—————
Report by, on Survey and Assessment for Khandeish. 1852.....	—————

FROM THE 26TH NOV. 1855 TO THE 24TH NOV. 1856.

ANNALS, Indian, of Medical Science, half-yearly Journal of, Nos. 4, 5, and 6 (2 copies of each).....	Medical Board.
ANNUAL Police Return showing the state of Crime in the Town and Island of Bombay during the years 1853-54	Govt. of Bombay.
Report of the South India Christian School Book Society for 1855.....	The Society.

DONORS.

ANTIQUARISK Tidskrift Udgivet af det Kongelige Nordiske Oldskrift-Selskab, from 1846 to 1854.....	The Society.
ASSOCIATION, Bombay, Minutes of proceedings of the third Annual General Meeting of. 1856.	The Association.
BROCKAUS (Von Hermann) Die Lieder des Hafis Ersten Bandes Zweites Heft	The Society.
BUDHI VURDUK.....	The Publisher.
CIRCULAR ORDERS issued by Government in the Judicial Department on Police subjects, Vol. 2nd, from July 1853 to 30th September 1855	Govt. of Bombay.
CONYBEARE (H.), Map of the Native Town of Bombay, completed to 1855	The Author.
CONSTABLE (Lieut. C. G.), Memoir relative to the Hydrography of the Persian Gulf and the knowledge that we possess of that Sea..	_____
CORRESPONDENCE exhibiting the results of the scrutiny by the Inam Commission of the lists of Deccan Surinjams prepared in 1844 by Mr. Warden and revised in 1847 by Mr. Brown	Govt. of Bombay.
— on the nature and use of the Poona Duftur, &c.....	_____
— illustrative of the practice of the Peshwas' Government regarding Adoptions	_____
— regarding the concealment, by the Hereditary officers and others, of the Revenue Records, &c.	_____
— relating to a proposed Enactment for the regulation of places used for the disposal of Corpses in the Town and Island of Bombay	_____
— relating to the prohibition of burials in the Back Bay Sands, and Dr. Leith's Mortuary Report for 1854.....	[Bombay. Medical Board,
— relating to the suppression of Dacoity in Bengal, 1854-55.....	Govt. of India.
— relating to Vernacular education in the Lower Provinces of Bengal ; Returns	

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relative to the Native Printing Presses and Publications ; and Report of the Director of Public Instruction in the Lower Provinces, for the 1st quarter of 1855-56	Govt. of India.
CUNNINGHAM (Major A.), Bhilsa Topes ; or Buddhist Monuments of Central India. 1854.	Govt. of Bombay.
— Ladak, Physical, Statistical, and Historical ; with notices of surrounding countries by. 1854	———
DEATHS in Bombay during the year 1855.....	Medical Board.
HAINES (R., M.B.), Introductory Lecture by, delivered in the Grant Medical College on the 16th June 1856	The Author.
HENWOOD (W. J.), Report on the Metalliferous Deposits of Kumaon and Gurhwal in Northern India	Govt. of Bombay.
INSTITUTION, Royal, of Great Britain, Notices of the Meetings of the Members, Part V., for November 1854 and July 1855	The Society.
JACKSON (W. B.), Report by, on Darjeeling....	Govt. of India.
JAMES (Colonel), Abstracts from the Meteorological Observations taken at the Stations of the Royal Engineers in the year 1853-54 ..	[Directors. Hon'ble Court of
JOURNAL of the American Oriental Society, No. 1 of Vol. V.....	The Society.
LISTE des Membres de la Société Géologique de France.....	———
MEMOIRES de la Société Royale des Antiquaires du Nord. 1848-49.....	———
MEMORIAL of the Bombay Association to the Government of India on the subject of Public Works.....	The Association. [Directors. Hon'ble Court of
MINUTES of the Committee of Council of Education for England and Wales, 1855-56	Govt. of Bombay.
MISCELLANEOUS information connected with the Province of Sindh, 2 vols.	———
— information connected with the Petty States in the Rewa Kanta, Vol. 1st.....	———
— information connected with the Persian Gulf.....	———

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- MISCELLANEOUS information connected with the Native States under the control of the Political Superintendent of Pahlunpoor Govt. of Bombay.
- information connected with the Petty States of Junjeera, Jowar, &c., illustrated with a Map of each State..... ——————
- MORRIS (J.), Cases disposed of by the Sudder Dewanee Adawlut of Bombay, Part I. of Vol. II.; Part. II. of Vol. II.; and Part IV. of Vol. II.; compiled by..... ——————
- Cases disposed of by the Sudder Foujdaree Adawlut of Bombay, Nos. 1 to 4 for 1855-56; Nos. 5 and 6 of Vol. IV. for 1856; Nos. 1 and 2 of Vol. V., for January and February 1856; Nos. 3 and 4 of Vol. V.; No. 5 of Vol. V. for May 1856; No. 6 of Vol. V.; and No. 5 of Vol. VI.; compiled by. ——————
- NOTES on the Manufacture of Salt in the Tumlook Agency; Report on the Coal Mines of Lakodong in the Tinteah Hills; and Memorandum of the Results of an Examination of Gold-dust and Gold from Shurj Grooveen Govt. of India.
- on the Rock-cut Temples and Rock-cut Palaces near Ellora The Author.
- OBSERVATIONS, Magnetical and Meteorological, made at the Honorable East India Company's Observatory, Bombay, in the year 1853, under the superintendence of Lieut. E. Fergusson, I. N. Govt. of Bombay.
- OFFICIAL Correspondence relative to the Assessment of the Omerkote and Narra Districts in Sindh ——————
- O'SHAUGHNESSY (W. B.), Report on the Electric Telegraph between Calcutta and Kedgeree Govt. of India.
- PAPERS of 1853 and 1854 on the Damoodah Embankments, &c ——————
- relating to the Establishment of the Presidency College of Bengal, for 1854.... ——————

DONORS.

PAPERS relating to the Examination held at the Elphinstone College Institution, Bombay, December 1855	[Instruction. Director of Public
— relating to the Examination held at the Poona College, December 1855	—
— relating to the proposed Canal between Ooltdangagh and Dholppa, and a direct water communication between the Ganges and Calcutta	—
— relating to a project for Wet and Dry Docks in the Harbour of Bombay	Govt. of India.
PRATT (E.), Memorandum by, on Municipal Conservancy in the Districts of the Bombay Presidency, Sindh, and Sattara	—
RAFN (Af. C. C.), Nordbaernes Torbindelser Med Osten	The Society.
— Remarks on a Danish Runic Stone of the eleventh Century found in the central part of London. 1854	—
REPORT, Annual, of the Grant Medical College, Bombay, tenth year, Session 1855-56, (2 copies)	[pal. The Acting Princi-
— by the Collector of Kurrachee on the Hilly region forming the Western part of that Collectorate	—
— of Crime, and Result of the Administration of Criminal Justice in the Bombay Presidency, for the year 1854-55	—
— of Education in Sindh, forwarded March 1856	Govt. of Bombay.
— of the Civil Judicial Administration of the Bombay Presidency, for the years 1854 and 1855	[Instruction. Director of Public
— of the Juvenile Improvement Library ..	—
— of the Census taken on the 1st January 1855 of the Population of the Punjab Territories ; Papers connected with the Administration of Mysore, &c.....	Govt. of Bombay. The Committee.
— on Vaccination throughout the Bombay Presidency and Sindh, for 1854-55.....	—

DONORS.

REPORT on the Political States S. W. Frontier Agency and the wild Tribes bordering on the south frontier of Chittagong	Govt. of India.
RICKETTS (H.), papers by, relating to the South-west Frontier, comprising Reports on Purulia, &c.....	—
REVARA (J. H. da Cunha), Catalogo dos Manuscritos da Biblioteca publica Eborense, Tome I.	The Author.
— (J.), Descriptive account of a voyage from Lisbon to India	—
SAGA Jatwardar Konungs Hins Helga, &c. 1852.	The Society.
SCHLAGINTWEIT (Messrs.), Report by, upon the proceedings of the Magnetical Survey of India, and of the Researches connected with it in the Himalaya Mountains, from April to October 1855	Govt. of India.
SHORT (J.), Topographical Report by, of the Political Districts of Raigurh, Surungurh, &c.	—
SOCIETE de la Geographie de Paris, Bulletin de, Tome XI. Nos. 61 and 62 for January and February, 4 ^e Serie ; Nos. 63, 64, 65, and 66 of Tome XI.....	The Society.
SOCIETY, Asiatic, of Bengal, Journal of, No. 7 for 1855 and Nos. 1 to 4 for 1856	—
— Bombay, Geographical, Transactions of, from Dec. 1854 to March 1856. Vol. XII.	—
— Royal Asiatic, of Great Britain and Ireland, Journal of, Part II. of Vol. XVI, 1856.	—
— Royal Astronomical, proceedings of, No. 9 of Vol. XV. ; No. 1 of Vol. XVI. ; No. 3 of Vol. XVI. for January 1856 ; No. 4 of Vol. XVI. for February 1856, with a list of the Fellows of the R. A. Society ; No. 5 of Vol. XVI. ; No. 7, May 1856 ; No. 8 of Vol. XVI.	—
— Royal, proceedings of, Nos. 14 and 15 of Vol. VII. for 1855 ; Nos. 18, 19, and 20 of Vol. VIII. for 1856 ; No. 21 of Vol. VIII. ; No. 22 of Vol. VIII. for 1856	—

DONORS.

SOCIETY, Students' Literary and Scientific, Bom-	
bay, proceedings of, for the years 1854, 1855,	
and 1856	The Society.
STACK (Captain G.), Dictionary by, Sindhi and	
English	Govt. of Bombay.
STRACHEY (Captain H.), Physical Geography of	
Western Tibet. 8vo. 1854	
SUPPLEMENT to Selections of the Government	
of India No. VIII. ;—Papers relating to the	
Forests and Iron Mines in Kumaon	Govt. of India.
SYKES (Colonel W. H.), Address delivered by,	
at the ceremony of his Installation as the	
Lord Rector of Marischal College and	
University, Aberdeen. 1854.....	The Author.
— Statistics by, of Nice, Maritime. 1855..	
TASSY (M. G. de), Les Auteurs Hindustanis et	
leurs Ouvrages. 1855.....	
— La Rhétorique des Nations Musulmanes.	
1848.....	
WATSON (J. F.), on the Sanitary applications of	
Charcoal, &c. and on Ventilation (2 copies).	Medical Board.
WEBER (Dr. A.), Indische Studien Beiträge für	
die Kunde des Indischen Alterthums. Drit-	
ten Bandes, Zweites und Drittes Heft.....	
WILSON (Rev. J., DD.), History of the suppres-	
sion of Infanticide in Western India	
— Six Schools of Indian Philosophy	
YOUNG (R.), Book of the Precepts, or the Affirm-	
ative and Prohibitive Precepts, compiled by	
Rabbi Mozes Maimonides, &c.....	
— Hexaglot Pentateuch, or the Five Books	
of Moses, in the original Hebrew	
— Rabbinical Vocabulary, with lists of Ab-	
breviations and Analysis of the Grammar ..	
— Polyglot Reading Book, containing Chal-	
dees portions of Daniel and Ezra, with corre-	
sponding Hebrew, &c. (2 copies)	
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the Hebrew Scriptures of the Old Testament	
in Hebrew, &c.....	

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— Syriac version	_____
— Song of a Fjnnlandian Country Girl, in the original Finish, with literal Translations into Hebrew, &c.....	_____
ZEITSCHRIFT der Deutschen Morgenlandischen Gesellschaft. Herausgegeben von den Geschäftsführern. Zehnter Band 1st, 2nd, and 3rd Heft	The Society.

FOR THE MUSEUM.

ROM THE 28TH NOV. 1853 TO THE 27TH NOV. 1854.

Albatross, skin of, from the Cape of Good Hope	P. D. Setkhan, Esq.
Ampullaria, large specimens of, from a marsh midway between Ahmedabad and Rajcote, close to the Tank of Sholapoor	Major H. Aston.
Argillaceous Sandstone, specimens of, white and red, from the neighbourhood of Nagpoor; 35 pieces, bearing impressions of plants, chiefly ferns; 11 of layers of Estheria; 4 of worm-tracks; and 1 of a jaw of a fish	Rev. S: Hislop.
Antimony, specimen of, from Borneo.....	Major L. Jacob.
Bali-Literature, specimen of, written on Palmyra leaf	_____
Carapace of a young turtle (<i>Chelonia imbricata</i>) covered with the shell, from Macassar....	_____
Coal (brown) specimens of, mixed with Pyrites, from Waghadur, about 12 miles from Kur-rachee	G. Elander, Esq.
— specimen of, from Burdwan	J. Ritchie, Esq.
Coin, copper, (3) found in the bed of the Ner-budda close to Burman Ghât. Two are circular, about $\frac{1}{2}$ inch in diameter, and stamped	

DONORS.

on one side only with a leaf surrounded by a circle of dots; the third, about $\frac{1}{2}$ inch square, bearing a trident on one side, with an impression on the other, which is too indistinct for description.....	Capt. W.T. Nicolls.
Coral-tree (<i>Melitaea ochracea</i>) from Singapore.	Major L. Jacob.
Cornelians and sea-shells, chips of, from sites of deserted towns in the Desert near Jacobabad.	H.B.E. Frere, Esq.
Crocodile (extinct species), anterior part of upper jaw of, fossilized, from near Toat in the valley of the Bharan (Sindh); measuring $10\frac{1}{2}$ inches from the tip of the snout to the posterior part of the transverse suture of the palate; width of jaw at this part $7\frac{1}{4}$ inches, including the external borders of the alveolar processes; two holes for the lower teeth close to the snout $1\frac{1}{2}$ inch each in diameter; diameter of the second tooth back, which is the largest, $1\frac{3}{8}$ inch; nasal aperture 6 inches long and $3\frac{1}{2}$ broad in its widest part. The sandstone matrix in which this fossil was imbedded closely approaches that imbedding the fossil-bones of the Sewalik Hills, and also that imbedding the bones of Perim Island opposite the Nerbudda	[I. N. Lieut. H. Grounds,
Fibre and Gutta Percha, specimens of, from the Mudar or Milk-bush of the Punjab	Capt. W.T. Nicolls.
Fossil-wood, shells, bones, &c. from the neighbourhood of Saugor, in Central India	
— shells, specimens of, from ditto, found in the Intertrappean Lacustrine formation; and from the bone conglomerate at Burman Ghât, on the Nerbudda.....	Maj. G. Fulljames. Dr. Collier.
Galena, carbonate of lead, heavy-spar, and green carbonate of copper, specimens of, from the mines near Ajmeer	
— Ditto ditto from Chittore.....	
— and Pyrites from the Lead-mines near Ajmeer	
Hog, wild, lower jaw of, with tusks, from Borneo.	Major L. Jacob.

DONORS.

- Iron-ore, specimens of rich, black, magnetic, from Travancore Maj. Genl. Cullen.
- from the Keranch range of hills in the centre of the Jetch Doab. [I. N.
— vessel, shallow, round, one foot wide, with ears or handles; also pieces of pottery; dug out of a Scythian Circle at Takalgat, 20 miles S. of Nagpoor Lieut. H. Grounds,
- Kunkur (concretionary limestone), specimens of, from the recent Blue Clay on the Malabar Coast Rev. S. Hislop.
- Laterite and Basalt, specimens of, illustrative of the Geological formation of the Hill of Punalla, situated about 10 miles from Kolapoor Maj. Genl. Cullen.
- Limestone white metamorphic, large granular, specimen of, from Ceylon Dr. Broughton.
- nummulitic, and blue shale, specimens of, with fossils from the nummulitic strata of Sindh, collected by C. J. Stewart, Esq., Deputy Collector of Schwan, during his survey of the Khelat frontier of Sindh Dr. A. H. Leith.
- Madrepore corymbosa, a large and beautiful specimen of (upwards of 3 feet in diameter), from the northern end of the Cheriapani Reef, called by Horsburgh "Byramgore," the Northernmost, but one, of the Lacadive Islands J. B. E. Frere, Esq.
- Manis pentadactyla, skin of, from Rutnagher ry Lieut. Selby, I. N.
- Plate, Copper (1), large, and Bricks (2) from Wullee, formerly called Bhulapoor and afterwards Wulpura, near Bownugger. Dr. de Cresigny.
- (1), small, found near Barungaon in Guzerat. [C. S.
Relics, disinterred by A. F. Bellasis, Esq., from the site of the ancient city of Braminabad in Sindh; consisting of fragments of cornelian, agate, copper ore, lapis lazuli, pottery, earthen-ware; glass of white, blue, and W. E. Frere, Esq.,

DONORS.

- green colors ; beads of cornelian, agate, ruby, lapis lazuli; marbles; bangles made out of sections of large sea-shells; cowries; copper nails; and copper coins of different sizes [C. S.
W. E. Frere, Esq.,
- Relics, Corundum, cornelian chips, talc, beads of turquoise and cornelian, marbles, blue and uncoloured glass, fragments of copper and manufactures in brass, copper coins, pottery, tiles, charcoal, bones, shells, &c. A. F. Bellasis, Esq.
- Relief des Monte Rosa und Seunter ungebunden A. Schlagintweit.
- Rock-specimens (15) from the middle of the Pal Ghat, taken from four places, distant from each other about ten miles east and west, all consisting of gneiss with black mica Maj. Genl. Cullen.
- (27), consisting of pegmatite, white talciferous granular limestone, steatite of various kinds, rich iron-ore, and old sandstone conglomerate, from the neighbourhood of Nagpoor Rev. S. Hislop.
- (60), consisting of white limestone charged with *Alveolina* and *Cyclolina*, smoky-grey ditto with similarly coloured argillaceous strata and clay-slate, coal, &c. from the Bolan Pass. Some of the specimens of limestone are encrinitic Dr. A. H. Leith.
- consisting of gneiss, bearing garnet and cinnamon stone; black mica with garnet; graphite copper-ore (green carbonate); of coarse white granular limestone bearing graphite; of red and green garnet, pargasite, and idiocrase; of fine white decomposing pegmatite (kaolin); of white laterite. Of Tertiary Pliocene (?) concretionary travertin (old kunkur) bearing *Helix hortensis* (?) in a white semi-consolidated state. Of Tertiary Pliocene (?) rock composed of consolidated, calcareous, sandy beds raised above the sea

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and resting on gneiss. Of Miocene (?) limestone ; limestone abounding in cavities from which the carbonate of lime belonging to the shells they contained has been dissolved out. Coarse bluish miocene orbitoliferous limestone underlying the beds of lignite at Quilon. Laterite. Variegated sands ; sandy clays ; and beds of lignite ; carboniferous clays ; white, friable rocks like decomposing gneiss or kaolin, stated to contain organic remains (corals).—This interesting and valuable collection illustrates the rocks between Tinnevelly and Travancore, passing round the extremity of the mountains at Cape Comorin to the Westward, then up the coast as far as Cuddaputnum, inland to Oodeghery, and lastly along the high road to Trivandrum.....	Maj. Genl. Cullen.
Shale, Carboniferous, (200) specimens of, from Newcastle, bearing impressions of plants, illustrative of the vegetation of the Coal Period.—A very valuable and extensive collection	Dr. A. H. Leith.
Shells, recent, a collection of, from Malacca	Rev. Lindstedt.
Shorl-granite, specimen of, from the neighbourhood of Ajmeer.—The mica and shorl in very large crystals	Dr. Collier.
Sulphur, specimen of, from the Island of Java.....	[C.B. Lt. Col. Whittle [LL.D. R.S. Sinclair, Esq.,
Whale, dorsal vertebræ of (3)	
Wooden figure of a Bali-god from the temple of Kosumba	Major L. Jacob.
FROM THE 27TH NOV. 1854 TO THE 26TH NOV. 1855.	
Coins (Copper) Indo-Scythian (31), from a large collection in the possession of Major Hollings, Deputy Commissioner of the Sholapoor District in the Punjab	[I. N. Lieut. H. Grounds,

	DONORS.
Coin, Indo-Scythic, a book of impressions of, taken by means of the Muddar Gutta Percha.	[I. N. Lieut. II. Grounds,
Coin, Copper (1), Hindu, found in the mud of a tank at Poorundhur	Mr. Sargon.
Dentritic Sandstone, specimens of, from the Southern Muratha Country; also of Steatite of a hard crystalline structure, dark-green colour, from Akern, near Sawunt Warree, and Ramghur, on the Phonda Ghât	Capt. A. de Lisle.
Fibre, specimen of, from the Muddar Bush, and different kinds of cotton, with cloth and cord made from the former, grown in the Punjab.	[I. N. Lieut. II. Grounds,
Fossils, specimens of, from the tract which lies between the highest mountains behind Ber- bera and the sea. In this collection there are Terebratulæ, Pholodonny, Gryphœa, and Belemnites of the Jurassic age, like those of Cutch; also several shells and corals from the Tertiary Formation, in all amount- ing to upwards of 150 specimens	Capt. R. F. Burton.
— from the Nummulitic beds and other Tertiary deposits; together with pebbles of Hornblende, Syenite, and Limestone rocks from the Cabul River	[C. S. II. B. E. Frere, Esq.,
— from the older stratified rocks of the Punjab, also from the Eocene formation there.	Major Hollings.
Fragments (15), in <i>Terra Cotta</i> , of ornamental parts of a Buddhist Temple, found at the southern extremity of the Hyderabad range of Hills in Sindh. These remains are pre- cisely of the same kind as those forwarded from the ruined Temple near Joruck.....	[C. S. II. B. E. Frere, Esq.,
Geological specimens of a formation, 25 miles south of Trivandrum in Travancore, com- posed of the detritus of Gneiss, containing much Plumbago, also marine fossils	Maj. Genl. Cullen.
— specimens and fossils illustrative of the Geology of the tract which lies between the highest mountains behind Berbera and the sea	Capt. R. F. Burton.

DONORS.

Geological specimens of Syenite, Trapp, white crystalline Limestone, and Sandstone, also Fossils, from Nuggur Parker, on the edge of the Runn, and from the Thur or Great Desert.	[C. S. H.B.E.Frere,Esq.,
Gums and Rope-fibre, specimens of, collected at Berbera	Lieut. Hearne.
Hair-Ball, specimen of, from the stomach of a Sheep, in which there were eleven.....	Rev. Dr. Wilson.
Horns (pair, attached to the frontal bone) of the Solitary Bull, inhabiting the Western Ghâts of India	Capt. Bainbrigge.
Marbles, handsome collection of specimens of polished, and other decorative stones, together with rich red haematite in quartz rock, and a specimen of heavy spar.....	Major Hollings.
Nostoc, dried, specimens of, from Boordike in upper Sindh.....	[C. S. H.B.E.Frere,Esq., [C. S. II. Hebbert, Esq.,
Rupee (square) of the Emperor Akbar	[son, Esq., C. S.
Slabs (2), bearing inscriptions in Persian and Murrathee, from the Fort of Galna in Khandesh.	A. St.J. Richard-

FROM THE 26TH NOV. 1855 TO THE 24th NOV. 1856.

Coins, Silver (4), which were selected from a few of the same kind found at Kusba Thair, in the district of Nuldroog	Capt. M. Taylor.
Geological specimens, a collection of (28), from the Oolitic (?) Series, bearing impressions of Ferns, &c. in Coal-Shale, from Barkoi Amret, 90 miles NNW. of Nagpore	Rev. S. Hindop.
— ditto, bearing impressions of <i>Phyllotheca</i> in foliages in Sandstone, from Silewadi and Bharatwada; and Worm-tracks from Korhadji in the vicinity of Nagpore	—
— specimens of Porphyry from the same Province; and of Voysey's so-called fossil oyster shell bearing limestone, at Droog....	—
Gutta Percha, specimens of, and of the leaf, flower, seed, and bark of the Panchachathee tree from which it is obtained. Discover-	—

DONORS.

ed by Major Genl. Cullen, along the base of the Ghâts between Trivandrum and the town of Paulee in the Cochin Country	Maj. Genl. Cullen.
Laterite, specimens (4) of, from the Island of Salsette.....	Dr. Buist.
Lignite, specimens of mineral resin, pyrites, &c. from sedimentary strata lying under the Laterite at Rutnagherry	Dr. de Crespigny.
Medal, Bronze, $2\frac{1}{4}$ inches in diameter, bearing on the <i>obverse</i> the head of the donor with the words "Richard Sainthill, of Topsham, Devonshire, Numismatist, Bombay, January 28th, 1778—1855, L. C. Wyon, ft." ; and on the <i>reverse</i> a group of figures, round which are the words, "Irradiating the present—Restoring the past—Numismata—L. C. W."	R. Sainthill, Esq., through W. E. Frere, Esq., C. S.
Nauutilus Deluci, fragments of, from Sindh	A. F. Bellasis, Esq.
Photograph of a design for an Inlet Tower for the Water-works of Vehar, now in course of construction by the Government, for supplying Bombay with water	H. Conybeare, Esq.
Plaster-cast of a Baotrian Silver Coin.....	James Gibbs, Esq., C. S., through W.E. Frere, Esq.
Red earthen spheroidal balls, specimens of, which were found by Dr. Burn, Mr. Lyon, and Dr. Wilson, in a quarry of the red ferruginous clay at Mahableshwur, from six to twelve feet from the surface	Dr. Wilson.
Rock, Magnetic Granite, from the top of an insulated hill 800 ft. high near Trivandrum.—See an account of its examination in detail, Proceedings of the Trivandrum Museum Society, 21st December 1855, by J. A. Brown, Esq., pp. 4 and 89	Maj. Genl. Cullen.
Series (A) of specimens, numbered 1—12, of Granite, Gneiss, and Laterite, the latter never more than 200 yards from the two former respectively. Nos. 1 to 4 from Tallapilly, a district forming the north boundary of the	

DONORS.

Cochin State ; Nos. 5 and 6 from Trichoor, a central district ; Nos. 7 to 9 from Moo- goondapoorum, a SW. district ; Nos. 10 to 12 from Cannanore, the most southerly district, Capital Tripontary.....	General Cullen.
Slab (1), bearing Persian inscriptions, taken out of the old castle-walls of Galwa, 20 miles SW. of Khandesh	A. St.J. Richard- son, Esq.
Specimen of Flying Squid (<i>Ouychoteuthis angu-</i> <i>lata</i>), and Sucking Fish (<i>Echeniss remora</i>)	Dr. Johnstone.

ORIGINAL COMMUNICATIONS.

FROM THE 28TH NOV. 1853 TO THE 27TH NOV. 1854.

COMMUNICATED
BY

Bellasis, (A. F., Esq.), Observations by, on the ruined city of Bahminabad in Sindh.—20th April (see p. 413)	B. H. Ellis, Esq.
— Ground plan and elevation of house exca- vated among the ruins of ditto, with sketches of the pottery found there.—12th October..	The Author.
Broughton, (Dr. F.), Description of an earth- quake in the Kolhapoor Country in July 1853, with observations upon the Geological changes produced by it.—21st Sept. (p. 677)	—————
Carter, (H. J., Esq.), On Zoosperms in <i>Spon-</i> <i>gilla</i> .—24th Aug. (Ann. & Mag. Nat. Hist. vol. xiv.)	—————
Dhunjeebhoy Framjee, Esq., Rudiments of Pehlvi Grammar by.—23rd Feb. (Published by the Author)	—————
Ellis, (B. H., Esq.), Memorandum of the Mud Craters in Lus Beyla, visited in August 1853.—24th July (p. 676).	H.B.E.F.ere, Esq.
Fac-simile Transcript and Translation of a Copper- plate grant dug up at Veesapoor.—24th August (Recorded)	Govt. of BOMBAY.
Jones, (Comr. F.), Reply to the Rev. Dr. Wilson's inquiries respecting Sepulchral and other remains from the plains of Gerarah, for-	

- warded to the Government of Bombay.—*23rd February* (p. 672)
- Nicolls, (Capt. W. T.), Memorandum on Fossil-sites about Saugor in Central India.—*22nd December* (p. 671)
- Peyler, (W. E., Esq.), Extracts from a report by, on the proposed line of Road through the Valley of the Hubb from Kurrachee to Keneree.—*19th January* (Recorded)
- Stevenson, (Rev. J., D.D.), Parting visit to the Sahyadri Caves by.—*20th April* (p. 426) ..
- West, (A. A., Esq.), Description of the Caves and Cave-Temples in the Sattara Districts by.—*12th October* (p. 673)
- COMMUNICATED
BY
Govt. of Bombay.
- The Author.
- H.B.E. Frere, Esq.
- The Author.
- Rev. Dr. Wilson.

FROM THE 27TH NOV. 1854 TO THE 26TH NOV. 1855.

- Carter, (H. J., Esq.), on the Development of Gonidia (?) from the Cell-contents of the Characeæ, and on the Circulatory Movement of the Protoplasm.—*22nd February* (p. 521)
- Friederich, (R. L. Th., Esq.), Translations with Fac-Simile of a Rock Inscription in Sumatra by.—*11th October* (p. 691)
- of an Inscription from a Temple in Java by.—*Ditto* (p. 691)
- Impey, (Dr.), Description of the Caves of Bagh Rath (with drawings) by.—*28th December* (p. 543)
- Jacot (Colonel LeG.), Translation of a Copper-plate inscription, dated Shuk 910, in the possession of a Jain at Khareputan (presented by him to the Society, April 1851) in which reference is made to the founding of Bali, &c.—*11th October* (p. 691)
- (Colonel LeG.), a few Observations on ancient Coins found in Kutch.—*Ditto* (p. 691).
- Kirby, (Captain J. H.), Description of Ruins found in the bed of the Narra Supply-Channel.—*Ditto* (p. 692)
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- Col. LeG. Jacob.
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- The Author.
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H.B.E. Frere, Esq.,

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BY

H.B.E. Frere, Esq.,
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- Narrain Wiswanath, Memorandum by, of Omerkote and its Soda Princes.—14th June (p. 538).
 Preedy, (Capt. W. H.), Further accounts of the Ruins of Brahminabad in Sindh, by.—*Ditto.*
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- Notice of a number of old Wells on the ridge of a rocky ground extending North-East of Bamboora (with a Sketch), by.—25th January (Recorded)
- Schlagintweit (the Messrs.), Report on Meteorological observations made during a voyage from Southampton to Bombay, between the 20th of September and the 26th October 1854.—28th Dec. (See Beng. As. Jl.)..
- Trumpp, (Dr.), Essay on the Sindhian Alphabets.—28th December (p. 685)
- Wilson, (Rev. Dr. J.), Review of the present state of Oriental, Physical, and Antiquarian Research in the West of India.—23rd November (p. 497)

The Author.

Rev. Dr. Wilson.

The Author.

FROM THE 26TH NOV. 1855 TO THE 24TH NOV. 1860.

- Buist (G., LL.D.), Observations by, on the Transformation of Trap into Laterite.—13th March (p. 700)
- Carter, (H. J., Esq.), Notes by, on Freshwater Infusoria in the Island of Bombay. No. 1, Organization.—10th January (p. 429)
- On the Development of the Root-Cell and its Nucleus in *Chara verticillata*, Roxb.—10th July (p. 521)
- On the Transformation of Vegetable Protoplasm into *Actinophrys* (p. 592)—13th November
- Frere (H. B. E., Esq.), Note by, on the Luminous Water in the Sea between Bombay and Aden.—28th February (p. 698).....
- Spiegel (Profr.), Extract of a letter from, to the Rev. J. Murray Mitchell.—14th August (p. 703)

Rev. J. M. Mitchell.

PROCEEDINGS, OFFICIAL, LITERARY, AND SCIENTIFIC.

FROM THE 28TH NOV. 1853 TO THE 27TH NOV. 1854.

Memorandum on Fossil Sites near Saugor, in Central India. By Captain W. T. Nicolls, Madras Army.—This interesting communication is accompanied by a sketch map of the neighbourhood of Saugor, indicating the position of the fossil-sites known to Captain Nicolls, also a descriptive list of the last valuable collection which Captain Nicolls presented to the Society, with references to the localities in the sketch map from which they respectively came.

The communication itself contains many valuable observations with respect to the relative position of the basaltic hills, and shelly limestone lacustrine deposits of India, in the neighbourhood of Saugor. The latter are sometimes merely overlaid by the regur, while the Oolitic (?) Sandstone hills being as numerous as the trappian ones, in this part of the country, and no other formation present, it would seem as though the lacustrine formation must rest on the sandstone where it has not been separated from it by the trap. Captain Nicolls' observations tend to confirm also Dr. Spilsbury's section of basalt overlying siliceous limestone and limestone conglomerate with fragments of boulders, $1\frac{1}{2}$ mile from Jubbulpore, (over which Prinsep threw a conjectural doubt), and which limestone, there, rests on "friable granitic sandstone."

With reference to the brown-coal above mentioned,* Mr. Elander states that it is to be found in many places in the Kurrachee Collectorate. It is probably of the upper Eocene or lower Miocene age, and connected with the blue-clay underlying the sand and conglomerates in the neighbourhood of Kurrachee.—22nd December 1853.

The letter from the Rev. Mr. Hislop announces the despatch of another box of rock-specimens, minerals, and fossils for the Society from the neighbourhood of Nagpur. In his letter also is the following paragraph respecting ancient sepulchral remains, similar to those described by Captain Meadows Taylor, (Vol. IV. p. 380 & the Society's Journal) :—

"At the top of the box there is an iron vessel like a frying-pan, but when complete, provided on each side with an ear or handle. Several years ago I dug it out of a Scythian stone-circle, at Takalghat, 20

* Page 660.

miles S. of Nagpur. When it was brought to light, at the height of about half an inch from the bottom it was covered over with fragments of pottery fitted to each other so as to form a kind of mosaic work, evidently to protect the ashes which were deposited in it. In the same cairn were found a spear-head, a piece of iron like a large knife or hatchet, nails, &c. At Takalghat there is a wide field for the antiquary. Indeed the country all round abounds in Scythian remains, but it would require a person with much leisure for their investigation. I am acquainted with about twenty localities where there are circles, and eight villages where there are Kistvaens in this district."

Of the recent fossil discoveries of the Rev. Messrs. Hislop and Hunter, the former states:—"The number of our fossils has not greatly increased of late. But since I wrote to you we have found some more animal remains in the sandstone. The jaw of a fish (?) mentioned above is an example. Such remains are generally accompanied by fish scales of the ganoid order, and hence I am inclined to think them remains of fish rather than of saurians. But we have got one very fine saurian head entire /the shape is that of an equilateral triangle, the neck constituting a base of about 5 inches. Like the *Labyrinthodon* and *Archegosaurus* it is covered with radiating grooved bones or scutes, but the distance between the orbit of the eye and the snout is less in proportion than in either of these. I have also fallen in with a pretty fruit, very much like a diminutive cocoanut. Those new discoveries are from Mangali, 60 miles south of Nagpur, where the sandstone is argillaceous and of deep red colour."

Commander Jones, in reply to certain inquiries by Dr. Wilson forwarded to him by Government, gives an account of the position in which the funeral remains forwarded by him last year were found at Gehrarah, and his own estimate of their peculiarities and antiquity. The place at which they were got, he considers the site of the ancient Kilwatha. The coffin or sarcophagus and sepulchral cover, he is of opinion have no connexion either with Mahomedans or Christians; but may belong to the earlier Greek era of Mesopotamia. Their accompaniments, he thinks, may have been the utensils supposed to be necessary for the dead interred in them on entering Hades and encountering Charon.

Dr. Wilson, with reference to this reply of Commander Jones, observed, that though, in the first instance, he had stated certain difficulties, and made certain inquiries about these remains, he is perfectly satisfied about their antiquity, as he had shown at the conclusion of

his second Memoir on the Antiquities of Western India, &c., in the Society's Journal for last year (Vol. IV. p. 372), to which he begged to refer Commander Jones for further information about the view which he had ultimately taken of them.—*23rd February 1854.*

In a note from Mr. A. Young, which is enclosed in Mr. Frere's, accompanying the crocodilian fossil abovementioned,* the former states that the place where such fossils, with mammalian remains also, are found near Sehwan, is about five or six miles west of this town, in a direct line between Bajar and the Lukkee Pass. They are imbedded in a consolidated sandy deposit like that on which Sehwan is built, but most are lying loose in the dry beds of small water-courses. It is difficult (Mr. Young states) to say from whence the Sehwan sand-stone could have come; the grit is but slightly calcareous, and the red does not effervesce with acid. Mud eruptions containing gypseous beds were observed in the neighbourhood of the locality where the bones were found.

Major LeGrand Jacob, who writes from Singapore on the 3rd instant, forwarding the presents abovementioned† from the Rev. Mr. Lindstedt and himself, states, with reference to the Sanskrit inscription which he presented to the Society in 1851, that "the pleasant sea-girt town of Bali" therein mentioned, does not appear to be the Island of Bali in the Eastern Archipelago, as he had thought, but some place in India. Mr. Friederick (Librarian of the Batavian Society) to whom he has given a copy of the inscription, and who has written some excellent articles on Bali (two of which are in the Journal of the Eastern Archipelago), having been sent there expressly by the Dutch Government to inquire into the languages, literature, and religion of the people, has promised to study this inscription and to communicate with the Society respecting it. Major Jacob further adds, that his chief object in writing is to impress upon the Society the importance of Bali and its neighbourhood as promising clues to many of our Indian mysteries; advises that copies of the *Purans* should be given or lent to Mr. Friederick, that he might point out what was new and what acknowledged in Java, as this would throw light on Hindu Chronology; and also suggests, that the Society should, through the assistance of the Batavian Society, obtain copies of the present Bali religious works claiming any degree of antiquity.

* Page 601.

† Page 604.

Under the title abovementioned* Dr. Stevenson states, that in his journey to and from Ahmednuggur, he took the opportunity of visiting the caves at Karlen and Junir; the advance of the season and other circumstances prevented his going to the caves of Nassik, though he had no important doubts to solve in them. The object in view was to ascertain how far the lithographed copies of the cave inscriptions lately published by the Society were to be depended on, and whether the change he had ventured to make in some of them were warranted by the originals engraved on the rocks.

After a careful examination and comparison, Dr. Stevenson came to the conclusion that Mr. Brett's fac-similes were in general very exact, and that the reduction of them in the Society's Journal had, on the whole been faithfully executed. Also, that where parts of the letters had become obliterated, Mr. Brett had for the most part supplied them with just discrimination.

There were, however, a few exceptions to this, which Dr. Stevenson then enumerated and explained, alluding to the different lithographed copies in which they were to be found; and concluded as follows:—

"As I may not again have an opportunity of addressing the Society, I embrace the present occasion to express my gratitude to the Members for the favourable reception they have given to my papers on Indian Antiquities. Without the advantages of the Library of the Society however,—the stimulus afforded by the success of my fellow-labourers in this and in other departments, especially the Geological,—and the advantage of such a medium of communication with the public as the Society's Journal furnishes,—it is not likely that my attention would have been directed to such subjects at all, or, if directed, that I should have been able to persevere in their successful prosecution."

Mr. Bellasis observes respecting the ruined town of Brahminabad †—

"The Deputy Collector of Halla and myself visited the ancient and ruined city of Brahminabad, situated on one of the branches of the Narra, called the Jerari, now dry. The city is enclosed within a fort-wall, well defended and mounted with numerous bastions and towers. These walls are very nearly four miles in circumference measured by a perambulator. Besides Brahminabad, at the distance of one and a half miles is the ruined city of Dolora, and five miles in another direction the ruined city of Jerar Gangra, and between these several cities are the remains of suburbs and villages for miles round.

* "Parting Visit to the Sahyadri Caves," p. 660.

† Page 413.

"Amid the chaos of ruins of brickwork are several open squares and bazars of great extent, and the most prominent object is a tower, also of brickwork, standing isolated on a large head of ruins.

"I selected a heap standing on the verge of the principal bazar for excavation. I had not commenced many minutes before I came upon the edge of a wall; clearing it, I soon came upon a cross wall, and then upon another and another. I had not dug to the depth of two feet before I came upon quantities of human bones, and at that and greater depths bones were so numerous, that it was hardly possible to dig a shovel-full without bringing up particles of bones. As far as I could judge, many were undeniably human bones, and others of cattle and of horses; the human bones were chiefly found in the corners of the rooms and in-doors, as if in days of yore the idea prevailed that there was safety in a corner. Many of the skeletons were in a sufficiently perfect state to enable me to decide whether they were in upright or reclining positions. One in particular I remember finding in a doorway, the man had evidently been rushing out of his house when a huge heap of brick-work crushed him to the ground, where his bones were lying extended full length and the face downwards.

"Besides bones, I found a large quantity of pottery of sorts, much of it of a very superior description to any I see made now-a-days in Sindh (a good deal of the pottery was glazed in colours of great brilliancy); stones for grinding grain; a grain jar, also of pottery, some five feet in depth, and two feet at the mouth, was found sunk in one of the rooms; quantities of cornelian chips, pieces of agate, and balls beautifully turned of ivory, agate, and other stone; coins, chiefly of copper, some few of silver; beads, and ornaments of cornelian in great variety.

"The most curious relic I found was an octagonal piece of what I imagine to be ivory, with inscriptions on each side, similar to the Sanskrit or Devanagari character; and also a signet with the same character.

"Finding such success during the first day's excavations, I increased the number of excavators from 20 to 70. In the three days I was at Brahminabad I excavated three distinct houses, two on one side and one on the other side of a street running out of the bazar.

"A plan of the excavations, a map of the city and neighbourhood, with a more detailed account of the relics found, I propose to draw out on my return to Hyderabad. I look upon Brahminabad as a wonderfully curious place, and I think the popular account that it was destroyed by an earthquake highly probable."

The Rev. Dr. Wilson laid before the meeting a drawing of an apparently undescribed species of *Gannetta*, which had been caught at Love-grove, and on which he proposed to make some observations on a future occasion.—20th April 1854.

Memorandum on the Mud-Craters in Lus Beyla, visited in August 1853. By B. H. Ellis, Esq., Assistant Commissioner in Sindh.—The author's object in this paper on the mud-volcanoes of Lus Beyla, is to record a description of their forms, &c. at the time he visited them, and by comparing this with the descriptions of the late Captain Hart (1839) and Captain Robertson (August 1849), [this Journal, vol. iii. part 2, p. 8] to show the alterations that have taken place in the groups which were visited by all three parties.

Specimens of the mud, sulphur, gypsum, shells, &c. alluded to in the memorandum, were presented to the Society on the 17th November last.

In the group first visited, viz. those called the "Raja Ram Chunder Koops," the diameter of the crater in the highest volcano (which is 57 feet) is within a few inches of that given by Captain Robertson, but the points of ebullition and overflow, instead of being on the southern side, as stated by Captains Hart and Robertson, are now, the former in the NW. part and the latter between the N. and E. points.

Also in the small volcano of this group, the crater, which was almost quiescent at Captain Hart's visit, is now as active as that of its neighbour, and its diameter greater and sides thicker than at that period.

In the next group visited, viz. the *Kamal-i-put*, situated near the sea-shore, there does not appear to be much alteration; Mr. Ellis did not see the fifth crater there, mentioned by Captain Robertson; and the cone described by him as rising in the centre of the crater of the great volcano no longer exists, though traces are present of its having fallen in; while a few feet from it there is another truncated cone, at a depth of twelve feet from the orifice of which is mud in strong ebullition; the orifice of this cone is three feet in diameter.

In the other large volcano of this group, the number of small basins appears to have increased, while the activity of the muddy ebullition has decreased, since the visit of Captain Robertson.

The other groups visited by Captain Robertson, the party had not time to visit.

Mr. Ellis in conclusion states, "I trust that others with greater leisure will be able to visit this interesting locality and add to the scanty amount of information which is now on record regarding it."—27th July 1854.

Description of an Earthquake which took place in the Kolhapoor Country in July 1853; with observations upon the Geological changes therewith connected. By Francis Broughton, Esq., Assistant Surgeon, Bombay Army.—The author states that the hill upon which the fortress of Punalla is situated, about ten miles from Kolhapoor, was shaken by an earthquake on the 14th July 1853. The shock was not very violent and no lives were lost, but the houses and temples of a village in the vicinity were much injured.

After a few observations on the manner in which such convulsions, with the disintegration of the rock, which is at present going on, may increase the arable soil in the Kolhapoor Country, Dr. Broughton goes on to describe the hill of Punalla, which is 975 feet above the plain, and composed of laterite, supported on prismatic pillars of basalt, the columns of which, being of different heights, here and there present narrow ledges, on which are situated villages and cultivation.

On the night of the day mentioned, the inhabitants of one of these villages were "disturbed by a perceptible trembling of the earth, accompanied by a loud hissing noise, as of escaping steam. The shock was thrice repeated, and lasted about two minutes; but the sound continued nearly a quarter of an hour."

"The solid masonry of a substantially constructed temple was cracked through from base to pediment; many buildings fell; and houses were so distorted that the walls opened, and door-frames were crushed or bent from the usual position. The startled sleepers were in some instances hurt by falling stones, and the watchman, whilst proceeding to alarm the Patell or chief Native authority, was astonished by finding his progress opposed by a chasm which crossed the main street of the village. This chasm or fissure was afterwards found to run due east and west, and to be about two and a half to three feet wide, of immense depth, and extended upwards into the hill side, where it was lost at the junction of the laterite with the basalt. Huge masses of earth and enormous boulders were scattered among the trees, which in a great degree protected the village from injury; and here and there a gigantic pillar, broken into fantastic fragments, had fallen over and completely obstructed the road."

The author next alludes to the danger of villages being built on the ledges mentioned, and the means by which the people who at present dwell there might be compelled, without actual force, to withdraw their habitations from such dangerous localities. In conclusion, he also notices the existence of "an ancient and capacious reservoir now in ruins," which is situated in the neighbourhood of the fissure already

described, and through the massive wall of which is a large rent that destroyed the reservoir, and which the author thinks must have been produced by an earthquake like the one mentioned.

Dr. Buist stated that this was the only instance recorded of actual alteration in the earth's surface by earthquake in this part of India, south of the 20th degree of north latitude: that no mention was made of any earthquake south of this degree by Captain Baird Smith in his compilations on the subject, and therefore the circumstance was well worth remembering. He also observed that no shock of an earthquake south of the 18th degree of north latitude had been recorded [Punalla is situated in about $16^{\circ} 38' N. L.$] The limited nature of the alteration, and the great violence attending it, were also remarkable facts.—
21st September 1854.

With reference to Mr. H. B. E. Frere's letter, dated 1st instant, suggesting the desirableness of publishing an abstract of Mr. Bellasis' paper on the ruins of the ancient city of Brahminabad, mentioned among the presents for the Library, the Meeting resolved—that as a small issue of papers printed in this way was sure almost to end in their being altogether lost after a few years, the one in question, or an abstract of it, whichever might be thought most advisable, should, in accordance with Mr. Frere's suggestion, be inserted in the next number of the Society's Journal. (See p. 413, &c.)

Description of the Caves and Cave-Temples in the Sátrá Districts.
By Arthur A. West, Esq., C. E. Communicated by the Rev. Dr. Wilson, Honorary President of the Society.—Dr. Wilson, on laying Mr. West's paper on the Caves and Cave-Temples of the Sátrá Districts before the Society, remarked that it contained a particular and accurate description of no fewer than ten series of groups of caves in the province to which it refers, which had been all personally visited and surveyed, and, in a few instances, discovered by Mr. West, whose zeal in antiquarian research merited much commendation, more particularly when it is considered that he is an active volunteer in the cause. In these groups there are three *Chaityas*, or temple excavations; ten *Dahgobs*, or depositories of relics; thirteen *Vihars*, or monasteries; fifty-nine large excavations, mostly with adjoining cells; forty-six smaller excavations; and a total of 122 excavations. Of the groups, five are Buddhistical; three Brahminical; and two doubtful. Hindu *Jatras*, or religious fairs, are now annually held at most of them, particularly in the months of April, August, and

October. They are all found in a district about 80 miles in length by from 50 to 60 in breadth. Dr. Wilson mentioned that he believed that a close examination of the *Khoras* and spurs of the Sáhyádri range in all portions of the Maráthá Country, especially where there are passes to and from the Konkan, would reveal an equal number of religious excavations. The fact is that their numbers in this part of the country are incredibly great.

Mr. West states that owing to the coarseness of the rock in which these excavations are executed, they present nothing of special interest in an artistic point of view. He characterises them as "wretched specimens of misapplied labour," only interesting in a historical point of view, as illustrating the hold which religious systems now passed or vanishing away had of this part of India. They must, he thinks, have been all plastered internally, principally with mud. Traces of only two inscriptions are to be found at them ; and of these probably nothing can be made.

The Buddhist images of the excavations of the West of India, Dr. Wilson added, are of a Hamitic type, the Buddhist priests having chosen this type as illustrative of their "points of beauty." This is not because they had any connection with Africa in the days of old, but perhaps because Shákya Muni, or Buddha himself, belonged to a Hamitic Scythian tribe, that of the *Sacæ*. The earliest immigrations into India which can be traced were of Scythian origin ; and such immigrations were of a periodical character for many ages. The non-Sanskrit elements of the vernacular languages of India are principally Scythian, additional light on which would be cast by an examination of Mr. Norris's decipherment and translation of the Scythian cuneiform inscriptions at Behistun, which would reveal some curious coincidences even with the Gujarátí, as in the first personal pronoun *hun*, I, the inflexion for the genitive of nouns, and some nouns in their pure form. Even the Hindu *Kusha* of the Puranas is not, as imagined by some, the secondary *Cush* of Africa, but the primary *Cush* of Gen. ii. 15, encompassed by the Gihon, or Oxus.—12th October 1854.

ANNIVERSARY MEETING.

The *President* having called for the Report of the Committee of Management for 1853, the *Secretary* read as follows :—

GENTLEMEN,—During the past year eight Resident and three Non-Resident Members have been elected. There have been 119 books and

pamphlets presented to the Library ; fifty donations to the Museum ; and thirteen original communications read at the monthly meetings.

To the Library 191 works, consisting of 336 volumes, have been added by purchase ; 772 volumes, comprising about an equal number of octavos, quartos, and folios, have been rebound ; 60 repainted ; and 417 files of old Newspapers have been collated and stitched.

The total number of Periodicals, Newspapers, Army Lists, and Almanacs received by the Society has been 72, viz. 40 Literary and Scientific Periodicals and Journals, of which 6 are presented by the Societies who publish them, in exchange for the Society's Journal ; 24 Newspapers, and 8 Calendars, Army Lists, and Almanacs.

Your Committee regret that the Alphabetical Catalogue is but little more advanced than it was last year ; at the same time it has been so far completed, that any one well acquainted with Literary and Scientific publications could easily pass it through the Press, and such a person your Committee trusts may soon be found, whose services being remunerated might further insure the publication of this work in a satisfactory manner.

The usual annual number of the Society's Journal has been published, viz. No. XIX. ; and, in accordance with the resolution of the Society passed at its Anniversary Meeting held in November 1853, had been distributed to the Members gratuitously.

Amongst the donations of the Museum, your Committee would particularise those of Major General Cullen, Political Resident in Travancore, and Captain W. T. Nicolls, of the 24th Regiment Madras N. I., now at Saugor in Central India, who, in addition to former contributions from their respective localities, have enriched the Museum during the past year with some of the most interesting and valuable collections of fossils and geological specimens that it has ever received.

It is with regret that your Committee find the Secretary's duties so increased, as to oblige him to state, that without assistance he will not be able to carry on the business of the Society, and we therefore, at his suggestion, submit that the old custom of the Society should be resumed and some one requested to take part of those duties as Joint Secretary.

The Auditor's report shows a smaller balance in favour of the Society than that of last year, but for this your Committee were prepared, on account of the reduction of the subscription of Non-Resident Members from Rs. 30 to 15 per annum, and the gratuitous distribution of a copy of the Journal to each of the Members, both Resident and Non-Resident, in lieu of to those only who originally subscribed for it.

Further, the Auditors observe that at present the Society receives no interest for its capital, and that as there is always a considerable sum in hand during the greater part of the year, it would be desirable to transfer this from the present Bank to another, or to a Mercantile House allowing interest on current accounts—a proposition in which your Committee entirely concur, and therefore recommend that it should be carried into effect.

Lastly, your Committee would bring to the notice of the Society the want of room that exists in the Society's Library, which occasions some hundreds of volumes to be placed behind others, where they cannot be seen; also the same want of room in the Museum; disadvantages which of course considerably diminish the use of both these departments: but the funds of the Society being totally inadequate to meet the expense which the alterations and additions necessary to supply these deficiencies would entail, your Committee do not feel prepared to go further than to record these facts for the future consideration of the Society.

The Rev. Dr. Wilson, seconded by T. L. Jenkins, Esq., proposed that the Committee's Report should be accepted, with the best thanks of the Society for their valuable services during the past year, which was unanimously carried.

The Rev. P. Anderson, *Vice-President*, seconded by Colonel Waddington, C.B., *Vice-President*, proposed, in accordance with the Committee's suggestion, that R. S. Sinclair, Esq., A.M., Professor of Mathematics in the Elphinstone Institution, should be appointed Joint Secretary, which was also unanimously carried.

Professor Sinclair having expressed his thanks for the honour conferred on him, stated that he would be happy to assist in the performance of the duties of Secretary to the best of his ability.

The following gentlemen were elected for the Committee of Management, Museum Committee, and Auditors for the ensuing year:—

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Committee of Management.

W. Howard, Esq.	Captain J. G. Forbes.
Rev. G. Cook.	T. L. Jenkins, Esq.
A. H. Leith, Esq.	J. Ritchie, Esq.
J. Harkness, Esq.	M. Stovell, Esq.
H. L. Anderson, Esq.	C. J. Erskine, Esq.

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Museum Committee.

A. H. Leith, Esq.	H. J. Carter, Esq.
T. L. Jenkins, Esq.	G. Buist, Esq., LL.D.
J. Harkness, Esq.	R. S. Sinclair, Esq.

Auditors.

Captain J. G. Forbes. H. B. Gilmore, Esq.

It was resolved that the "Cape Town Mail" should be discontinued and the "Cape Monitor" taken in its stead; also that the "North British Review," the French and English "Illustrated News," and the "Economist" should be added to the list of periodicals.—27th Nov. 1854.

FROM THE 27TH NOV. 1854 TO THE 26TH NOV. 1855.

The following letter from W. E. Frere, Esq., was read:—

MY DEAR DR. CARTER,—I must beg you to allow every consideration for an invalid, and one on the point of leaving India, and pardon my great neglect in not having written you till this moment to beg you would lay before the Anniversary Meeting my resignation of the office of President.

It is with great regret that I resign it after so short a tenure of office, and without having been able to do one single thing for the benefit of the Society.

I commenced to make some progress in the arrangement of the coins, but was unable to complete it. If however, when in England, I can do anything for the Society, I shall rejoice in the opportunity, and I still hope, on my return, that in an inferior situation I yet may be permitted to do all in my power to aid the Society, whose interests I beg to assure you I have very much at heart.—Believe me, &c.

(Signed) W. E. FRERE.

Malabar Hill, 27th Nov. 1854.

It was then proposed by the Rev. Dr. Wilson, Honorary President, seconded by Dr. Stovell, and carried unanimously:—

"That the Society record its great regret at having been so soon deprived of Mr. Frere's valuable services, and especially that this should have been occasioned by illness; also its hope that at the expiration of Mr. Frere's intended residence in Europe he may return with full restoration of health to realize that hope, so kindly expressed in the concluding part of the note tendering his resignation."*

In answer to Professor Eastwick's letter, presenting the copy of his work above mentioned (p. 648) it was resolved:—

* As Mr. Frere's letter, by accident, did not arrive until after the business of the Anniversary Meeting had been concluded, it was read at the following Meeting, and the above "Resolution" recorded, but no one elected to succeed him, for the reasons stated at p. 688.

" That in communicating the best thanks of the Society to him for his valuable present, Professor Eastwick should be informed that the copies of the Society's Journal formerly sent through him, at his request, to the Library of the Hailybury College and the Berlin Library, should be considered as presents, and that the rule passed at the Anniversary Meeting of 1853, mentioning the sum that should entitle members to a copy of the Society's publications, should be forwarded to him in reply to that part of his letter proposing an arrangement of this kind regarding himself.

Description of the Caves of Bagh in Rath, with drawings. By E. Impey, Esq.*—Dr. Impey states, that "although the caves of Bagh in Rath were described by Lieut. Dangerfield, an amended and more detailed description has become necessary from the author's discovery of several large Vihars in connection with them, and from their peculiarities as a series, which is perhaps as perfect as any brought to light heretofore, and in magnificence and size surpasses even Adjunta, that is as far as they extend.

"The defect in them has been the absence of a *Temple-Cave* or *Chaitya*, but is remedied by the object of worship (the Daghaba) being placed in a chamber by itself in the rear of the cave, which is remarkable and a departure from the general practice of the Buddhists; but seems peculiar to Malwa, where image-worship was little resorted to; the Daghaba—as representing the relics of Buddh, being the principal object of adoration, as in the caves of Dumhar and those recently discovered by the author at Koolvee, derived probably from the presence in the country (at Sanchi) of the Great Stupa,—the purest type of the Buddhist religion in its original state.

"Another peculiarity in these caves is that of a large dome or cenotaph in the principal one, which is very singular, but indisputable. From the comparative insignificance of the Daghaba in the rear, it is not improbable that there was a larger one under the dome, but it is left to conjecture entirely to supply a receptacle, for the debris of the roof have entirely choked it up.

"There are evidences also of a large colonade, 220 feet long, supported by 20 pillars 14 feet high, with painting in bright colours covering the surface of the verandah behind and extending over the fronts of a Vihar and school-room or banqueting hall, which is the most perfect of its kind known, and is connected with an assemblage of cells differing from all others, which seem to have been set apart for titular superiors.

* See this "Paper" *in extenso*, p. 543.

"The caves are cut in a sandstone formation of a soft nature, and the paintings consequently supply the place of sculpture, both interiorly and exteriorly. They are considerably defaced and were only brought to light by varnish. They are divided into compartments representing sets of dancers and musicians, and of horses and elephants, in procession towards a figure of Buddh seated in an arbor in the attitude of expounding, and probably were meant to refer to the consecration of the cave and of the relic shrine.

"That their comparative size may be understood, the proportions of other known Vihars are then given as follows :—

No. 16 at Adjunta	67 feet by 65½.
„ 17 „	64 „ by 63.
„ 1 „	64 „ square.
Keneri Vihar.....	96 „ by 42.
No. 2 at Bagh.....	94 „ square.
„ 1 „	88 „ „
„ 5 „	86 „ „

"The Dherwarra at Ellora is 110 per cent. but this includes the side cells, and 18 feet being deducted (9 to each), the remainder 92 proves it to be less than the Bagh Caves.

"In respect to the dates of these caves, the author conceives that they were excavated in the reign of Chandragupta, who ruled in Malwa in the 4th century A. D., under the cognomen of Vicramaditya the Second, and according to Prinsep's and Cunningham's reading of the Sanchi inscriptions, was a most liberal supporter of the Buddhists. This date is adopted in preference to the later one assumed by Mr. Fergusson, of between 6th and 10th centuries, both from the known decline of Buddhism at the later period, the persecutions of the Buddhists by Shankar Acharya in that century, and from the reign of Siladitya, the only Buddhist prince of note in Malwa in the 7th century, being chiefly occupied with war and conquest; in addition to which, it is to be presumed that the worship of the Buddhists at that period would have shown more corruption and admixture of Brahminical emblems; whereas, in the paintings, sculpture, and objects of worship, the Bagh Caves bear strong similitude to those at Sanchi, which are considered emblematic of all that is pure in Buddhism.

"The author conceives that the gradations of cave-architecture are deceptive sources of chronologic accuracy or classification, and that different eras are rather characterised by differences in decoration and delineation of figures than by execution, in fact rather than by any

variety of design or proportion in the caves themselves, which is common with Indian architecture generally, that is, devoid of any architectural pretensions; massiveness and decoration being the chief features of art with them, the former in a measure imposed on them from the nature of their work and the preponderance of weight, and the latter designed to relieve and carry off the defect of the first.

The author also conceives that the caves were designs from *structural* buildings, from the appearance of streets and cross beams in the roofs. Vihars in Ceylon having been built in the 1st and 2nd century B.C., and also those ordered by Asoka in India about the same period, which correspond with the Brahminical Maths of the present day.

Essay on the Sindian Alphabets. By the Reverend Dr. Trumpp, Communicated by the Reverend Dr. Wilson.—In laying Dr. Trumpp's paper on the Sindian alphabet before the meeting, Dr. Wilson remarked that it was composed with a full recognition of the true principles of oriental philology. The Sindian, Dr. T. considers a genuine Arian language. Its ancient Indian alphabet was perfectly suited for its expression, till, by the Mahomedan conquests, a large stock of Arabic and Persian words, amounting to about a fifth of the whole language as it now exists, was engrafted upon it. "The Musulmans, Dr. Trumpp writes, in their sovereign contempt of the Hindús, disdained to adopt an alphabet from their subjects, and transferred the holy letter of the Koran to the uncouth tongue of Sindh. The few, who attempted to write in Sindhi, were compelled to load the Arabic alphabet with a confusing heap of dots and other diacritical marks. The Hindús on the other side declined to augment their present store of letters with new ones, or diacritical marks, which had become necessary by the introduction of Semitic words, for the expression of those sounds they possessed no adequate letters. The consequence was, that their respective writing remained hieroglyphic to each other, and the Hindús in particular had no reason to wish for publicity of their writing (which, however, was restrained to their mercantile accounts), as their hieroglyphic character was rather a protection against the avarice of their bigotted Moslem rulers. It is, however, self-evident, that if knowledge shall be spread amongst Hindús and Musulmans, one of the two alphabets must admit the words of the strange tongue within its pale, and which alphabet would best be adapted to give the exact sounds, we will elucidate by comparing the different alphabets." After reviewing the Sanskrit, Arabic, Persian, Sindian, and Hindustani alphabets, Dr. T. determines in favour of the last men-

tioned as capable of expressing the peculiarities of both Indian and Arabic words.

Report on Meteorological Observations made during a Voyage from Southampton to Bombay, between the 20th of September and the 26th October 1854. By A. Schlagintweit, H. Schlagintweit, and R. Schlagintweit, Esqs. Communicated by the Secretary.—The Report by the Messrs. Schlagintweit consists of tables of observations on the temperature and specific gravity of the sea-water at different depths in the Atlantic and other seas, through which they passed on their way from England to Bombay; and the authors promise a further report on the temperature of the air and on the moisture in different elevations above the level of these seas, as well as of the two experiments which they made in the Mediterranean and Red Sea on the quantity of carbonic acid contained in the atmosphere of these two localities.—*28th December 1854.*

Resolved—“That the Secretary be requested to inform Messrs. Smith, Taylor, and Co., and Messrs. Thacker and Co., of the yearly expenditure of the Society for books, and to request the favour of them, respectively, to furnish terms on which they could supply the Society.”

Resolved—“That the letter No. 702, dated 17th February 1855, from the Secretary to Government, General Department, with enclosed despatch No. 59, dated 29th December 1854, from the Honorable the Court of Directors, be handed over for the information and guidance of the Cave-Temple Commission.”

The Honorable Court, in their despatch (No. 59 of 1854), comment on the great expense which the entertainment of Mr. Fallon for planning and illustrating the Cave-Temples and their sculptures has entailed, also the expense attending the employment of Mr. Butt to copy the Cave-Temple Inscriptions, and request that, at the expiration of Mr. Fallon's present engagement, photography may be substituted for both these purposes.

The Honorable Court also mention that Captain Biggs, of the Bombay Artillery, is an excellent photographist; and the Government, in accordance with their recommendation, have been pleased to appoint this officer to succeed Mr. Fallon in June next.—*22nd Feb. 1855.*

A Special Meeting of the Society was held in its library, on Saturday the 7th April 1855, for the reception of Lieutenant-Colonel

Rawlinson, C.B., and to afford him an opportunity of giving a *vivæ* account of his latest researches and discoveries in Assyria and Babylonia.*—Sp. M. 7th April 1855.

The letter, accompanied by the volumes of the Transactions of the Wisconsin State Agricultural Society, (mentioned under the head of Presents for the Library) requesting that in return it might be presented with copies of the publications of the Bombay Branch of the Royal Asiatic Society—

It was resolved, that a complete copy of the Journal should be forwarded to the Wisconsin Society by the first opportunity, with a letter of thanks for their Transactions, and accepting their proposed terms of exchange.

With reference to the question of transferring the Book-business of the Society from the London Booksellers to a Bookseller in Bombay, the *Secretary* stated, that in accordance with the proposition of the Society passed at its meeting held on the 22nd February last, Messrs. Smith, Taylor, and Co. and Messrs. Thacker and Cb. had been addressed on the subject, and that letters containing their terms respectively had been received.

These letters were read, and after some discussion the following resolution, proposed by T. L. Jenkins, Esq., seconded by the Rev. Dr. Wilson, was unanimously carried, viz:—

1st. That on account of the increased facility of obtaining books from England and the establishment of Booksellers and Houses of Agency in Bombay, with whom the Society can communicate direct, the Society are of opinion that the time has arrived when the difficulties attending the transactions of this part of their business at a distance can be greatly lessened, and the Society's objects much advanced by availing themselves of the opportunities offered on the spot; and that although they are of course exceedingly unwilling to leave those who have served them with such fidelity and judiciousness as their present Booksellers for so many years past, they nevertheless feel conscious that the changes mentioned (which the shortness of trans. has induced) and the advantages to be derived from them, now necessitate their transferring this part of their business to a firm in Bombay.

2nd. That as the terms proposed in the letter from Messrs. Smith, Taylor, and Co. are more favourable to the Society's interest than those of any other applicant, and consignments of the Society's

* See p. 478.

Journal for sale have for some years past been in the hands of Smith, Elder, and Co., of whom they are the Agents,—Messrs. Smith, Taylor, and Co. be appointed the Society's Booksellers, and the Committee of Management requested to make the necessary arrangements for transferring their Book-business from the London Booksellers to this firm, with as little delay as possible.

With reference to the election of *President* and *Vice-Presidents*, it was proposed by the Rev. Dr. Wilson, seconded by Dr. Arbuckle, and carried unanimously—

"That on account of the short time that would elapse before the return of Mr. Frere, and the great interest he took in the Society's affairs rendering it desirable that he should be re-elected, the election of *President* be postponed until his return, or until the Anniversary Meeting of the Society in November next: also that the election of the *Vice-Presidents* be deferred until that time.

The propositions of Mr. Erskine for admitting the Graduates of the Grant Medical College and first Students of the Elphinstone Institution to certain privileges of the Society gratis, having been brought forward—

It was proposed by C. J. Davies, Esq., seconded by Captain J. G. Forbes, and carried unanimously, that as they involved an alteration of the fundamental rules of the Society, their discussion should be postponed until the Anniversary Meeting.

Remains of Buddhist ornamental Architecture in Sind.—Among the fragments of *terra cotta* ornaments mentioned in the presents to the Museum* are a figure of Buddh in a sitting posture with the legs drawn up; a head with a curled wig similar to those seen in the caves of Elephanta; an elephant's head; and figures of the lotus, together with fragments of cornices. Of these ornamental remains Mr. Frere states as follows:—"We found them in several spots from Syudpoor, about half-way between Moolakattyar and Mahomed Khan's Tanda, to Sida Soodehu, where the ruins of a tower is situated, built of unburnt brick faced with large burnt bricks, at the junction of the Goonee and Fullailee, about six miles north of Mahomed Khan's Tanda. This, we were told was the ruins of a light-house, which existed here when the sea came up the Goonee and ships used to come hither, and was built by the Beni Israel, in the time of the Prophets, before the days of the Kasir kings."

The specimen of *Nostoc* mentioned in the presents to the Museum, which very much resembles *N. collinum*, Kg., was sent to Mr. Frere by Lieutenant Cowper, Acting Collector Shikarpur, with the following note :—

"I send you herewith a small specimen of a substance said to have fallen last month in Boondika, just a little beyond the Bigaree Canal. The weather was showery at the time, and the substance was pretty thickly strewed over a space of two or three miles square. The Natives described it as a shower of "gosht" (meat) which they said it resembled, being, when fresh, of a soft pulpy consistence and like flesh in colour."

The Secretary stated that this substance, now consisting of dry and shapeless fragments, would, after having been placed in water for a few hours, resume its natural gelatinous form, and thus reveal its true character. It was an Alga called *Nostoc*, not far removed in the vegetable kingdom from the sea-weeds, which are frequently boiled down into jelly for food, and in China, as well as in some other countries, certain species of *Nostoc* were commonly eaten. The Sindians were, therefore, not far wrong in calling it *gosht* or meat; and from the inconceivable smallness of the germs from which it is first generated, like the green which makes its appearance over objects that have never been exposed to the monsoon, yet present this colour a few days after it has commenced, the germs of this *Nostoc* might have been brought through the air to the place where they at the appointed time for their germination passed into visible forms, which having no earthly origin that the ignorant Sindians could conceive, and coming into tangible masses just after a storm, not unnaturally led to the conclusion that they must have been showered down from the heavens. - Happily many of these events which appeared miraculous to the ignorant for some wise purpose, and give rise to scepticism among many at the present day because they are not understood, derive explanations from Science which defy all attempt at disbelief. It was wonderful to the Sindian to see what he could only conceive to be a substance rained from heaven; it is, not less wonderful to the Naturalist, who can trace this substance to its germs, to wonder even still more how these were first generated and how they go on uninterruptedly and unerringly producing their like. Thus does the Creator keep up his power of eliciting wonder and admiration from the most ignorant to the most learned !

Of the collection of geological specimens and fossils from Berbera above mentioned, Lieutenant Burton states that the latter are chiefly found on the plain of Berbera, and the former, in the following order,

between the sea and the summits of the mountains (600 feet high) above it ; that is, the ridge immediately behind Berbera.

" 1st. Country along the coast consists of a Coraline Limestone (Tertiary Formation?) with drifts of sand, &c.

" 2nd. Sub-Ghauts and lower ranges (say 2000 feet high) of Sandstone capped with Limestone, the former proponderating.

" 3rd. Above the Ghauts a plateau of Primitive Rocks mixed with sandstone, granite, syenite, mica schiste, quartz rock, micaceous grit, &c."

The fawn-coloured fossils from his Coraline Limestone are evidently the same as those of the tertiary formation along the SE. coast of Arabia, and therefore the same as those of Cutch ; and it is exceedingly interesting to find that among the blue-coloured fossils, which are accompanied by specimens of the blue shale composing the beds from which they have been weathered out, are species of *Terebratula* and *Belemnites*,* identical with those figured in Grant's Geology of Cutch.—~~14th~~ June 1855.

The Committee of Management having met, in accordance with the resolutions of the Society passed at their Meeting held on the 14th June last, respecting the transfer of their Book-business from the London Booksellers to a Bookseller in Bombay, resolved :—

I. That letters be written to Messrs. Longman and Co. and Mr. J. M. Richardson, respectively, forwarding—1st, A copy of the Society's resolutions respecting this transfer. 2nd, Stating their desire, if convenient, that the transfer should be made on the 1st of January 1856. 3rd, Requesting that any arrangements that they had already made, which could not be conveniently closed by the end of the year, might be continued, the same being made known to the Society by return of post if practicable ; and 4th, Stating that Messrs. Smith, Taylor, and Co., in Bombay, would be prepared to take on the supply of the Society with books and periodicals from the 1st January 1856. (See letter in Letter Book, No. 49, dated 29th July 1855).

II. That Messrs. Smith, Taylor, and Co. be informed that the Society would be happy to accept the terms for the supplying of the Society with books and periodicals mentioned in their letter dated 9th March last. 2nd, That a copy of the letter forwarded to Messrs. Longman and Co., and Mr. J. M. Richardson, be also forwarded for the information and guidance of Messrs. Smith, Taylor, and Co. 3rd, That a list of all the periodicals, serial works, and other publications of the kind be

* See a further account of these fossils, p. 638.

forwarded to Messrs. Smith, Taylor, and Co., with a request that they will be prepared to take on the supply of the same from 1st January 1856, as well as that of all other books required by the Society, after the manner and terms expressed in their letter. 4th, That Messrs. Smith, Taylor, and Co. be requested to send in the list of new publications, alluded to in para. 6 of their letter, on the Monday preceding the second Thursday of every month.—16th July 1855.

It having been observed by the Secretary that he had had great difficulty latterly in getting sufficient Members present to form a quorum for the election of Members;

It was proposed by Colonel Jacob, seconded by C. J. Davies, Esq., C. S., that the following proposition should be brought before the next Anniversary Meeting :—

“That on account of the difficulty of obtaining a sufficient number of Members to form a quorum for the election of gentlemen proposed as Members of the Society, votes on such occasions be allowed to be tendered by written proxy addressed to the Secretary.”

Specimens of *Phyllum siccifolia* with eggs, were laid before the Meeting by Colonel LeGrand Jacob, who had brought them from Batavia in Java.

Colonel Jacob stated, with reference to the Island of Bali, that Mr. Friederich, the Secretary of the Batavian Literary and Scientific Society, believed it to have been colonized from Java, and not directly from India, only a short time before the fall of its last Hindu kingdom at Majapabit, an event of comparatively recent occurrence. This is Mr. Friederich's main reason for thinking the “Bali” of the copper-plate inscription formerly given to the Society by Colonel Jacob, not to mean this island.

Respecting some coins belonging to His Highness the Rao of Cutch, which were dug up in Cutch just before Colonel Jacob's departure for Australia, and which he stated he had taken with him for decyphermant, he observed, that one set were of the late dynasty termed *Sah* (in which he read *Sasa* sometimes curtailed to *Sa*), which dynasty reigned a century or two B. C.; the others were “Guptas” perhaps of the same dynasty, but reigning at a very doubtful time after.

Colonel Jacob also stated, that at the next Meeting of the Society he would present Mr. Friederich's translation of the Sumatra and Java inscriptions, referring, the first plainly, the second obscurely, to the union of the *Sivaistic* and *Buddhistic* faiths.

Java, he observed, abounded with relics of Hinduism in both of these forms, and was a most interesting country for an Indian antiquary, but the adjoining Island of Bali is still more worthy of note, exhibiting as it were a piece of India chipped off at some remote period from the continent, and since kept as separate as Herculancum from modern Italy. There, Hinduism is found in its four great divisions, the practice of Sati, and the Hindu scriptures in another tongue ; but Colonel Jacob would not enlarge on this interesting subject further than to express surprise that so little attention has been paid to it by Anglo-Indians.—13th September 1855.

The Rev. Dr. Wilson, *Honorary President*, Colonel Jacob, and Brigadier J. Hale having proposed Mr. R. H. Th. Friederich, Secretary to the Batavian Literary and Scientific Society, as an Honorary Member of the Society, the ballot for that gentleman's election will be held at the next Meeting, in accordance with the rules of the Society.

Colonel Jacob, seconded by Dr. Wilson, also proposed—

"That the thanks of the Society be tendered to Mr. Friederich, for the books formerly presented by him through Colonel Jacob to the Society, as well as for the translations, &c. of the inscriptions from Sumatra and Java now on the table ; also, that a complete copy of the Society's Journal be forwarded in return to Mr. Friederich, by the earliest opportunity ; and that at the same time the Society's hope be expressed that he will continue to favour them with similar communications, for which Bali especially, and the Dutch possessions generally, in the Eastern Archipelago, offer such an interesting field for research. Further, that the hope be expressed that Mr. Friederich will turn his attention to a publication with translation of the *Brahma Purana* of Bali, in which work the Society feel a deep interest, and would be happy to second his labours in this respect to the extent of their power." This proposition was unanimously carried.

Ruins found in the bed of the Narra.—Captain Kirby states that in excavating the great Narra Canal about two miles and a half from the town of Roree, the foundations of a number of houses were laid bare ; they were about ten feet below the surface, and composed of stone-work alone or mixed with bricks.

In proceeding from Roree, the first of the ruins met with consisted of a large wall, about four feet thick, which extended from one side of the canal about 100 feet inwards. This wall, which was built of bricks,

Captain Kirby thinks might have been part of the old town-wall. From this point foundations of houses extend south-easterly for 700 feet. Amongst the ruins were found several articles made of brick-clay, such as drinking cups, a water-jar, some water-spouts, and a large number of children's toys. There were also found some round stones, which appeared to have been used as weights ; one was equal to two chittacks, another to four, and a third to six.

The town appears to have been built on the extremity of a rocky hill, and to have been "gradually" covered by mud held in suspension by the waters which deposited it. The burial-ground still remains uncovered. Huckrah would appear to have been the name of the town, which is still retained by a village in the neighbourhood.

The Secretary then read an extract from a letter from the Rev. J. Murray Mitchell, enclosing one from Professor Spiegel of Erlangen, to his address, respecting his recent investigations into the ancient languages and literature of Persia.

Dr. Wilson regretted much that the interesting communication of Professor Spiegel* had incidentally come before the Society at a meeting pledged by its circular to give its principal attention to the matters to be submitted to it by their able and zealous member, Colonel Jacob ; for many of the topics to which it briefly adverted were worthy of particular notice. With other papers which he had lately observed, it afforded hopes that the time was fast approaching when there would be only one opinion entertained among Orientalists about the various questions which had been raised about the languages and literature both of Eastern and Western Irán. He was sorry that Mr. Spiegel had not entered into explanations with their venerable associate, Mr. Romer, for certain he was, that he would have encountered no lack of courtesy or philological appreciation in that quarter. He the more readily expressed this conviction that he (Dr. W.) did not take the same view of the *Avastá* language that does Mr. Romer, by whom its genuineness is suspected on the ground of its close resemblance to the Sanskrit, on the basis of which he held it was fabricated by the Parsí Priests.. Mr. Romer had already got considerable relief in his difficulties by the admission of Orientalists that the "Old Persian" was "not the offspring," but a "sister or cousin" of the *Avastá* language, commonly called Zend ; while, on the other hand, his suspicions were confirmed by the doubts which were thrown over the language of the translations of the Zend, sometimes called Pehlvi or Huzvarish. To this transla-

tion-language, Mr. Spiegel's inquiries, it would appear, have been lately directed; and all due attention would be given to his researches and their results. One sentence of his letter was well worthy of attention:—"I am not of the opinion that the Pehlvi language was ever spoken in the form we have before us." This opinion is certainly correct, if the mode of reading that language (with a very imperfect alphabet and some equivocal letters) resorted to by the Pārsis be assumed to be tolerably near the original; but it is also possible to read many of the words in another way, as held by the late Mulláh Firuz and his successor Mulláh Rustamji, by which *many* (not the whole) of the supposed Shemitic words are resolvable into pure Persian, as is the case in the word *Anhuma*, which may be read *Hūrmazda*, with its various spellings, without any violence to its literal forms. But these remarks were made only with reference to the views of Mr. Romer. On matters at issue among the students of the Pehlvi, he (Dr. W.) would perhaps make a few remarks in the paper on Oriental and Physical Research connected with the West of India* which he hoped to be able today before the Society at its next meeting. With regard to the "Zend," he had long ago arrived at the conclusion that its primitive seat was Eastern Irán, or Bactria and its neighbouring districts. The system of faith and political institutions unfolded in the Avastá differed in some not unimportant respects from those ascribed to the Persian Empire by the classical writers and the Achaemenian tablets, while they agreed in others; and, as indicated by Professor Westergaard in his highly interesting introduction to the Zend Texts, the publication of which has just been concluded, and by Professor Spiegel in the letter now read, it was only in later times transferred to the West of Persia. It was probably only in the days of Ardeshir Babegán that the collection of the Zend pieces was formed, though some of them were of far more ancient composition, even extending perhaps to the days of Dejoces. The most ancient Avastá pieces, however, are certainly later than those contained in the Indian Vedas, for the grammatical and vocabulary archaisms of the Indian Vedas (on which the Reverend Mr. Anderson had just been interrogating him) are not to be found in them, while with many resemblances to the religion of the Vedas, they have their antagonisms to it which show posteriority. The Sun (*Asura* sometimes) is a god in the Vedas, with only subordinate attention, while he is the chief deity of the Zend writings, endowed with intellectual and moral attributes, Ahuro-Mazdā (Hormazd), the multiscient Sun or Lord, while in another form he is *Hvarē-Kshaeta*, the Resplendent or Ruling

Sun, or *Khurshid*. *Indra*, with the highest place in the *Vedas*, is a devil in the Zend writings, in which the Vedic word for *God* is throughout used for *devil*. The *Avastá* refuses to notice the benevolent genii by their original names, though they are the Amshásplands of the Parsis, still denominated and praised according to their supposed qualities; and all this is in protest against the growing gross idolatry of the Indians. With most of the minor gods of the *Vedas* the *Avastá* had not interfered.

On concluding, Dr. Wilson, on seeing so many of his Pársí friends present, expressed his satisfaction that they were not altogether standing aloof from the interesting inquiries to which their literature is giving rise. Mr. Dhanjibhái Frámjí had practically evinced his willingness to co-operate with his European brethren by publishing a brief grammar of the Pehlvi as commonly read by the Pársís. The universally respected family of Sir Jamsetjee Jejeebhoy could assist these brethren, by consenting to the publication of the Pehlvi *Wajar-Kard*, which had now been in type for several years, but not yet put into the hands of the public, though individual copies, like one possessed by himself, had found their exit from the stores of the Sir Jamsetjee Translation Fund. That work might do much good in assisting a fair and honest literary criticism, even independently of the more serious religious inquiries which it might raise.

Major Cunningham exhibited to the Society several interesting drawings and fac-similes of Indian Antiquities, the originals of some of which he conceived bore the impress of Greek or Bactrian art. He also left with the Society copies of a valuable inscription at Gwalior which has not yet been deciphered.—11th October 1855.

Mr. R. H. Th. Friederich was unanimously elected an Honorary Member of the Society.—22nd November 1855.

ANNIVERSARY MEETING.

MONDAY, 26TH NOV. 1855.

The *Secretary*, at the request of the Rev. Dr. Wilson, *Honorary President*, in the Chair, read the following Report of the *Committee of Management* for the past year:—

GENTLEMEN,—During the past year 13 Resident and 3 Non-Resident Members have been elected.

There have been 167 books and pamphlets presented to the Library; 17 donations to the Museum; and 12 Original Communications have been read at the monthly Meetings.

To the Library 232 works, comprising 356 volumes, have been added by purchase ; 305 works, or 318 volumes, consisting of about an equal number of octavos, quartos, and folios, have been rebound, and 14 repaired.

The total number of Periodicals, Newspapers, Calendars, Army Lists, and Almanacs received by the Society has been 92, viz. 53 Literary and Scientific periodicals and journals, of which 23 have been presented by the Societies who publish them ; 29 Newspapers, and 10 Calendars, Army Lists, and Almanacs.

Arrangements, in accordance with the Society's resolutions passed at their Meeting held on the 14th June last, have been made with the Home-Booksellers, viz. Messrs. Longman, Brown, and Co. and Mr. J. M. Richardson, for the transfer of the Society's Book-business, on the 1st of January 1856, from their hands to Messrs. Smith, Taylor, and Co. at Bombay, Agents for Smith, Elder, and Co. at London, and letters have been received in reply from the former, of a most satisfactory kind, regretting the change though admitting the reasons assigned by the Society to be conclusive of its expediency.

Comparing the present Report with that of the year before last, we observe a slight increase in the number of Members elected, as well as an increase in the number of books added by purchase and presented to the Library. A greater number of books have been rebound, while the balance in favour of the Society is but a few ruppes less.

Your Committee have still to regret that the Catalogue of the Library, though now as far advanced as it can be without the aid of one well acquainted with the publications of ancient and modern Literature and Science, still remains unprinted for want of a person so experienced to conduct it through the press ; while no one has been found to undertake the Editorship of the Journal, which the Secretary on account of his numerous avocations has been compelled to postpone.

In conclusion, your Committee would recommend that the Librarian's salary, which is now Rs. 70 (seventy), should be increased to Rs. 80 (eighty) *per mensem*, in accordance with the Society's Resolution passed at its Meeting held on the 10th June 1852, which, not contemnplating the delay above-mentioned in the printing of the Catalogue after the MSS. and arrangement of the books had been prepared by the Librarian, promised him this increase of his salary at this period.

It was then proposed by Dr. Peet, seconded by Dr. Arbuckle, and carried unanimously—That the Committee's Report be received, and the best thanks of the Society voted to them for their valuable services during the past year.

The *President* and remaining three *Vice-Presidents* of the Society for the past year were re-elected.

The Rev. G. Cook, seconded by Dr. Don, proposed that Professor J. Harkness should be elected to fill the vacant office among the *Vice-Presidents*, which was unanimously carried.

The following gentlemen were elected for the Committee of Management, Museum Committee, and Auditors for the ensuing year, respectively :—

Committee of Management.

W. Howard, Esq.	Captain J. G. Forbes.
The Rev. G. Cook.	T. L. Jenkins, Esq.
A. H. Leith, Esq.	M. Stovell, Esq.
Colonel J. Hale.	C. J. Erskine, Esq.
H. L. Anderson, Esq.	J. Don, Esq., M.D.

Museum Committee.

A. H. Leith, Esq.	H. J. Carter, Esq.
T. L. Jenkins, Esq.	G. Buist, Esq., LL.D.
J. Harkness, Esq.	R. S. Sinclair, Esq.

Auditors.

Captain J. G. Forbes.	Lieutenant J. T. Annesley.
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After some discussion on the "Propositions" of C. J. Erskine, Esq., C. S., for the admission of Graduates of the Grant Medical College and Students of the Elphinstone Institution, free access to the Library gratuitously, they were withdrawn by Mr. Erskine.

The proposition of Colonel LeGrand Jacob for allowing votes to be given by "written proxy" in the election of Members, from the difficulty of obtaining a *quorum* for this purpose, was rejected; 2 having voted for and 11 against it.

It having been proposed in the Circular calling the Meeting that the *Westminster Review* should be discontinued, 8 voted for and 4 against the proposition, which was thus carried.

Resolved that application be made through the proper authorities for supplying the Society with copies of the "Fort William," and "Fort St. George" Gazettes.

FROM THE 20TH NOV. 1855 TO THE 24TH NOV. 1856.

With reference to Dr. Buist's letter, drawing attention to the deficiency of local publications in the Society's Library both past

and present, and suggesting that all files of Newspapers, Almanacs, &c. published in the Presidency prior to 1818, should, as far as possible, be obtained; and that a "Reference Department of the Library should be specially provided as a receptacle for new works, newspaper files, &c."

It was resolved, that Dr. Buist's proposition should be submitted for the consideration and report of the Committee of Management.

It was also resolved, on a motion of Dr. Buist, that applications should be made through the proper channels for procuring copies of the "Agra Gazette," "Printed Selections from the Records of the N. W. Provinces," those of Bengal, and those which have not been received of the Bombay Presidency.

A letter from A. Way, Esq., Secretary Archeological Institute of Great Britain and Ireland, was read, relative to an abstract of a communication which Dr. Buist had made to the Society of the Scottish Antiquarians on the "Bows of the Ancients," and submitting for Dr. Buist's opinion a sketch of a bow made of dark-coloured horn, like that of the buffalo, found in the fens near Ely. Dr. Buist was of opinion that this bow (from the description and sketch, which closely resembled an Indian one that he laid before the Society) was "purely of oriental origin, identical with those used in many parts of India, and if so it was a very great curiosity."—10th January 1856.

Note on Luminous Water in the Sea between Bombay and Aden.
By H. B. E. Frere, Esq.—"About 8 P. M. on the 5th February 1856 we entered a patch of luminous water, and continued sailing through it with little intermission till day-break on the 6th. There were a few intervals of clear water, some of them 6 or 8 miles wide. As we were going about 9½ knots, the patch must have been at least 70 or 80 miles across. Close to the ship, as we looked down perpendicularly, where the water was agitated by the paddles and wake, the appearance was that of a milky fluid, clouding and gradually mixing with the clear water; at a little distance the milky hue seemed more diffused, and 20 or 30 yards off the water appeared of an uniformly milky tint, or as if the whole surface up to the horizon (which was very clearly defined against the dark sky) had been covered with snow. Night clear, and stars bright, with a few fleecy clouds, which had exactly the same pearl-white tinge as similar clouds have at night over a snow-covered landscape. Wind light from the NW. The milky appearance seemed to proceed from an infinite

number of small luminous points, and was rather stronger where the ripple from the ship's bows broke, but there was less than ordinary of the appearance of single brilliant phosphoric lights usually seen at this time of the year in these seas when the water is agitated. A bucket of water drawn up contained, as far as our naked eyes could discover, no greater abundance of phosphoric animalculæ than tropical sea-water generally contains. The luminous or milky appearance ceased as day dawned, and, when the sun rose the sea had no other than its usual appearance, unless it were a reddish-brown tinge, which might have been due to the ruddy morning clouds, though I fancied it was more general than it could have arisen from such a cause.

"I have seen something of the same kind twice before. Once about 80 miles from Bombay, in December 1853, when the night was very calm, and the edge of the luminous patch was so clearly defined that the captain of the steamer (*Bombay*) said, if he had not been sure of his reckoning he should have supposed it was a line of breakers. As we approached, the surface was sufficiently luminous to enable us to see further than we could have done with a bright moon half full, and when the ripple from the vessel, or a fish, disturbed the glassy surface, there was a flash of phosphoric light, and you could trace fish by the increased light of the line on which they moved at a depth of several feet."

"The other occasion was during the monsoon, at Manora, when a small patch appeared to be driven against the rocks, and for half the night made the heavy breakers brilliant to an unusual degree.

"At nightfall on the 6th the same appearance was seen, but the water was less milky, or rather the phosphorescence was less uniformly diffused, and there was a much greater proportion of very brilliant lights, both of the small star-like kind and of the masses as large as blubber-fish, of which there were great numbers about the vessel after dawn. The officers of the watch said that with more or less intermission the luminous appearance of the water continued through the night.

"About midnight on the 9th to 10th February we ran into a similar patch, much smaller than the former ones, but remarkable for diffused brightness and freedom from any particular spots larger or more brilliant than the others. The effect was exactly that of a sea of milk. Some clouds on the horizon were relieved against it so distinctly, that every one on deck thought they were the land, then some 50 or 60 miles distant, nor was it for sometime that the captain felt satisfied we had not even drifted in-shore by some unusual current."—*28th February 1856.*

Dr. Wilson, on behalf of the Cave-Commission, reported that at a meeting just held, the Commission had taken into consideration one of the recommendations made to the Society, in the address delivered at its meeting held on the 22nd November last, viz. that the Cave-Commission should take steps for the revision of the cave-inscriptions and their further translation and elucidation ; and that they united in the recommendation that the countenance and approbation of the Society should be given to the Commission in an application which it proposes to make to Government that it should be empowered by a monthly grant of fifty Rupees, in the first instance, to retain the services of Vishnu Shastri Bápat, a learned Bráhmán well-skilled in the cave-character and inscriptions, to aid them in their labours in this department.

The Meeting having approved of this measure, requested the Secretary of the Cave-Temple Commission to act accordingly.

Dr. Buist, on presenting to the Society a set of specimens of Trap in process of transformation into Laterite and other substances, made the following observations :—“ The singular rock called Laterite is, so far as appears from the writings of geologists, peculiar to India. It prevails all over Hindooostan, the Malayan Peninsula, and the Eastern Archipelago ; at all events from the 28th parallel S. I do not recollect to have seen it described as existing northward of the Sutledge, or indeed of Agra, although traps in those quarters are abundant. It is not made mention of as a recognized rock in any part of European America, though it surely might be looked for where a climate similar to that of Hindooostan, and rocks such as constitute our mountain ridges, occur together. Until of late years there has been no distinctly recognised theory of the origin of laterite. The majority of geologists consider it an independent muddy volcanic effusion. The lignite, copalite, and other organic remains found by General Cullen associated with it near Quilon, caused it for a time to be supposed a Neptunean rock, while for ten years back the tendency has been towards the theory of its being a decomposed trap.”

The difficulty of this explanation lies in the fact that laterite of nearly similar character is found prevailing over a great many varieties of rock, occasionally over limestone, as well as over those formations from whose disintegration exclusively it is assumed to be derived. In reality we are only now beginning to appreciate the almost numberless transformations, the decompositions and recompositions without end to which rocks, especially those abounding in iron, silica, and the alkalis are subject. In 1850 Mr. Ebelmen found that one

specimen of trap from Cornwall, consisting essentially of Labradorite and Pyroxene, lost by decomposition one-third of its silica, five-sixths of its lime, and half of its alkalis. A specimen of basalt from the Rhine lost by the influence of the weather two-thirds of its alkalis, a fourth of its lime, and about an eighth of its silica. These decompositions were attributed by him to carbonic acid and oxygen in the water, or to organic matters alive or in process of decomposition, and the processes thus in progress in Europe with sufficient celerity may be supposed to act with tenfold energy in India. In 1848 my attention was drawn to masses of rocky matter found imbedded everywhere in the red earth overlying our traps, and identical in everything save colour with the true laterite of the Ghâts ;—the latter has a bright red, the former is reddish brown. I prepared and forwarded at the time a paper to Colonel Sykes on the subject, when my faith in my own doctrine was subsequently shaken by a discussion on the subject on the spot, with the late Captain Newbold, an authority so very high, that it was not easy to avoid bowing before it. In 1852, our distinguished Secretary, Mr. Carter, laid before the Society a paper illustrative of the specimens and adopting the decomposition theory. I examined with him the substance *in situ* assumed to be laterite, and I have no doubt correctly. It formed a vein or bed in the black basalt of Worlā Hill, and in all respects appeared identical with the imbedded masses in the red earth of Sewree. Ten days since I had occasion to visit the caves of Kennery in hopes of assisting in solving the question as to the best mode of copying the inscriptions and of obtaining for the Government Central Museum clay or stucco-casts of these as well as of some of the sculptures. Less successful than I had hoped to be in the main object of inquiry, I was eminently fortunate in obtaining a magnificent suite of about a hundred varieties of trap and trappites in various stages of decomposition. The lower part of the Vihar Valley, betwixt the great dam and the Digh road, is closed in by a mass of diorite, partly dark-blue or greenish, in part ochry-yellow or buff, but all highly crystalline, and very slightly decomposed. Near the site of the great filtering tower there is a mass of black chert, obviously Neptunian rock, petrified, identical with that on which Sewree Fort stands, and this stratifies away along the hills to the westward, filling up a large portion of the channel of the stream near the caves of Kennery. At the spill-water again, where the first turf was cut by the Governor General in January last, a great variety of trappite with several amygdaloids present themselves. Two or three greenstone dykes, beautifully defined and occasionally columnar in structure, stretch across the

valley from nearly north-east to south-west. The great mass of hills around the caves consist of a variety of trappite precisely similar to that betwixt the Powder-Works at Mazagon and the "Mount;" the valley is peculiarly favorable for the study of trappean transformations, the rocks around, with the exception of the chert, being exclusively volcanic, so that all the material encountered, whatever its form, must necessarily be of trappean origin. The excavations forming material for the spill-water embankment exhibit nearly a dozen different kinds of soil, almost as unlike to each other as can possibly be conceived; some are pale ochry green, some rusty colour, others nut or reddish brown; some are bright blood red, rusty red, or brownish red, while the principal material in the valley, about eight feet thick, is obviously the genuine Regur, or black cotton soil of Western India. By the sea-shore we have other transformations, the blue clay constituting our sludge, or that of an earlier date furnishing the lagoon of the flats; or older still the bed containing mangrove roots under the littoral concrete of Mahim Wood and the Esplanade, must needs be of trappean origin, as there has never been any other rock where it exists to form it from. But this again only requires exposure to the sun, air, and rain to be transformed into the nut-brown soil of our rice fields, the little kunkur nodules prevailing in this generally possessing a scrap of oyster or other sea-shell as a nucleus of aggregation. The trap and the trappite specimens from Vihar are in all stages of transformation, the marked colour and singular structure of the laterite being always from the outset developed from certain centres of change. The process of transformation is different in different rocks. Greenstone generally sloughs off first into rusty scales, which change into a brownish or yellowish compact clay, and this again is transformed into the common red earth of our gardens. This latter material alters according to the treatment it receives. Perfectly barren when first exposed to the air, it absorbs carbon with the greatest avidity from any form of decomposing organic matters. It changes its colour from iron red to nut brown; the stony particles which form about three-fourths of its mass disappear, and the whole becomes transformed into rich fine clay forming the most fertile of our garden soils. Left again to the action of the rain without addition, the finer particles are washed away and furnish the only tolerable refractory potter's earth we possess. The stony particles remaining behind, increase in size and specific gravity by aggregation, assume a shining semi-metallic lustre, and by degrees become united into lumps of solid laterite. Sometimes these various processes are omitted, and in most of the softer trappites, or the debris of the Neptunean rocks of trappean origin

enclosed in them, the transformation is immediate and direct."—13th March 1856.

Mr. Frere stated respecting the coin just mentioned,* cast of which Mr. Gibbs had requested him to present to the Society, and which the latter considered one of Antiochus, that it appeared to be a very beautiful one and more perfect than the one presented by Sir A. Burns to the British Museum, of which there is a drawing in Plate iii. of the 2nd Volume of Burn's *Bokhara*. The coin is also mentioned in Wilson's "Ariana Antiqua" page 219, as one of Theodotus. Dr. Wilson being of opinion that so long as Theodotus professed obedience to the Seleucidian King, he struck coins in the name and with the device appropriate to Antiochus, and when he declared himself independant he continued the same coin but substituted his own name. Mr. Gibb's coin will therefore be a Bactrian struck by Theodotus (more properly Diodotus) before he revolted from Antiochus Theos and made Bactria an independant kingdom.—8th May 1856.

The Rev. P. Anderson's proposition, viz :—" That it is desirable that a new catalogue of the Society's books should be prepared on a new system, and that for this purpose the Secretary be requested to engage the services of a competent person, offering a sum not exceeding seven hundred Rupees as remuneration for the compiler's trouble"—having been brought forward and discussed, it was moved as an amendment,

"That the words 'Managing Committee' be substituted for the word 'Secretary' in the proposition, and that the words 'Rs. 1,000' be substituted for 'Rs. 700.'". The amendment having been put to the vote and carried unanimously, the original proposition was dropt.—10th July 1856.

Extract of a letter from Professor Spiegel to the Rev. J. M. Mitchell, dated Erlangen, 7th May 1856 :—" Since I last wrote to you I have been a good deal occupied, and my labours again have not been without results. The whole of the second volume of my edition of the Avestatext, Pahlavi translation and all, is in the press, and the printing is going on, without interruption. All my time is now spent in the German translation of the work, and the half of it is ready for the press, together with a rather long introduction, on the ceremonies of the

* Page 667.

Parsis. I hope the introduction will not be read without interest. I have been astonished myself by the close resemblance which the greater part of these ceremonies bears to the institutions of the Christian Church in the fifth and sixth centuries. However, there is nothing very puzzling in this fact, for the ancient Parsis, as I have had occasion to state before, studied in the Christian Schools of Syria and Persia. It was quite natural that they should take an interest in the religious discussions of their teachers and apply the results to their own religion, when that was possible. But I scarcely need to tell you that great as the similarity is in some instances, the difference in others is not less striking. My work on the traditional literature of the Parsis, and its connection with the other literatures of the East, will be ready for the press this autumn."—14th August 1856.

ANNIVERSARY MEETING.

MONDAY, 24TH Nov. 1856.

The *Secretary*, at the request of the *President*, read the following Report of the Committee of Management for the past year :—

GENTLEMEN,—During the past year 18 Resident, and 5 Non-Resident Members have been elected.

There have been 249 books and pamphlets presented to the Library; 13 donations to the Museum, and 8 Original Communications have been read at the monthly Meetings. To the Library 287 works, comprising 505 volumes, have been added by purchase; 167 works or 590 volumes, consisting of about an equal number of octavos, quartos, and folios, have been rebound and repaired.

The total number of Periodicals, Newspapers, Calendars, Army-lists, and Almanacs received by the Society has been 95, viz. 56 Literary and Scientific, of which 23 have been presented by the Societies, and 10 Calendars, Army-lists, and Almanacs inclusively.

This shows an increase over last year in the number of Members, both Resident and Non-Resident, who have been elected; a great increase in the number of donations to the Library, and a corresponding increase in the number of volumes purchased, bound and repaired; but there is a decrease in the number of presents for the Museum and the Original Communications have been unusually few compared with former years. The great increase to the Library has been through the purchase of Botanical books belonging to the late Dr. J. Stocks, which having been sold at auction in Bombay, enabled the Committee to supply the deficiencies in the "Class of Botany" at a very small expense compared

with that which the valuable books thus obtained would have cost in any other way. With reference to the printing of the new Catalogue, your Committee have received tenders for carrying this into effect, and trust that in a few months hence it will be completed. A good part of the XXth number of the Journal has passed through the Press, and it is hoped that it will be completed by January next.

The Report was accepted, and the best thanks of the Society voted to the Committee of Management for their valuable services during the past year.

The following Office-Bearers were elected for the ensuing year :—

President.

W. E. FRERE, Esq., C. S.

Vice-Presidents.

Maj. Genl. Waddington, C.B.	Rev. P. Anderson.
Hon'ble A. Malet.	John Harkness, LL.D.

Committee of Management.

A. H. Leith, M.D.	Rev. G. Cook.
Captain J. G. Forbes.	J. Don, M.D.
T. L. Jenkins, Esq.	E. I. Howard, Esq.
C. J. Erskine, Esq., C. S.	T. S. Cowie, Esq.
H. L. Anderson, Esq., C. S.	W. C. Coles, M.D.

Museum Committee.

A. H. Leith, M.D.	H. J. Carter, Esq.
T. L. Jenkins, Esq.	G. Buist, LL.D.
J. Harkness, LL.D.	R. S. Sinclair, LL.D.

Auditors.

Captain J. G. Forbes.	Lieutenant J. T. Annesley.
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Upon the proposition of Dr. Sinclair, the "Cambridge and Dublin Mathematical Journal" and "London University Journal" were added to the list of periodicals.

Patron.

The Right Hon'ble JOHN LORD ELPHINSTONE, G.C.H.

Honorary President.

The Rev. JOHN WILSON, D.D.

President, Vice-Presidents, Committees, and Auditors, as in the foregoing page.

Secretaries.

H. J. Carter, Esq. | R. S. Sinclair, LL.D.

Honorary Members.

1829* Chevalier Cesar Moreau, Paris.	1845 Le Marquis de Ferriere de Vayer.
1830 Sir J. Gardiner Wilkinson, London.	1848 Le Vicomte de Kerckhove, Antwerp.
1832 Monsieur Garcin de Tassy, Paris.	„ M. Eugene de Kerckhove, ditto.
1835 Baron C. Hugel, Vienna. „ A. S. Walne, Esq., Cairo.	„ M. Felix Bogaerts, ditto.
1839 Prof. T. Pavie, Paris.	1849 Captain Inglefield, R.N., London.
1842 N. L. Westergaard, K.D., Copenhagen.	„ B. Hodgson, Esq., B. C. S., ditto.
„ Prof. C. Lassen, Bonn.	1855 Rev. R. H. Th. Friederich, Batavia, Java.
„ M. M. Etienne de Quartremere, Paris.	„ Rev. John Stevenson, D.D., Ladykirk, Berwick.

Ordinary Members.

1816 E. E. Elliot, Esq., C. S.	1830†Colonel J. Hale.
„ Major General C. Waddington, C.B.	1831 W. E. Frere, Esq., C. S.
1828 Lieut. Colonel P. M. Melvill.	1832 H. Young, Esq., C. S.
1830 The Rev. John Wilson, D.D.	„ Colonel H. B. Turner.
„ †P. W. LeGeyt, Esq., C. S. (Calcutta.)	„ Colonel LeGrand Jacob.
„ Major General J. F. Schuler.	„ Dr. F. Harrison.
	1835 John Harkness, LL.D.
	1838 C. Morhead, M.D.

* The figures mark the year of election.

† Non-Resident Members in India.

1839†J. W. Winchester, Esq.	1848 The Rev. D. O. Allen. (America.)
1840 H. L. Anderson, Esq., C. S.	„ M. Davidass, Esq.
„ The Rev. J. M. Mitchell.	„ Venayek G. Shastree, Esq.
(Europe.)	„ †C. M. Harrison, Esq., C. S.
„ Manockjee Cursetjee, Esq.	„ †Major W. Whitelock.
„ G. Buist, LL.D.	„ †J. H. Wilmot, Esq.
1841 C. J. Erskine, Esq., C. S.	„ †Rev. J. Glasgow, D.D.
„ W. H. Harrison, Esq., C. S.	1849 The Rev. J. D. Gibson.
1842 Rev. G. Cook.	„ Captain J. G. Forbes.
„ H. J. Carter, Esq.	„ Thomas L. Jenkins, Esq.
„ †Captain W. E. Evans.	„ R. Mackenzie, Esq.
„ †M. B. E. Frere, Esq., C. S.	„ H. B. Gilmour, Esq.
1843†D. Costelloe, M.D.	„ G. W. Campbell, Esq.
1844†H. P. St. G. Tucker, Esq.,	„ A. H. Leith, M.D.
C. S.	„ F. S. Arnott, M.D.
„ †C. Forbes, Esq., C. S.	1850 Dhunjeebhoy Frangjee, Esq.
„ †Captain W. R. Dickinson.	„ John Ritchie, Esq.
1845 J. A. Baumbach, Esq.	„ Major W. Tremenhærc.
„ J. Peet, Esq.	„ B. White, Esq.
„ Juggonath Sunkersett, Esq.	„ †Colonel S. John. (Europe.)
1846 The Hon. A. Malet, Esq.,	„ †Major General Wyllie, C.B.
C. S.	1851 J. Graham, Esq. (Europe.)
„ M. Stovell, Esq.	„ Rustomjee Jamsetjee, Esq.
„ James Dou, M.D. (Europe.)	„ Sorabjee Jamsetjee, Esq.
„ Lestock Reid, Esq., C. S.	„ †Colonel C. Blood.
„ T. S. Cowie, Esq. (Europe.)	1852 Colonel H. Lyons.
„ †E. P. Down, Esq., C. S.	„ R. Strong, Esq.
„ †Captain W. F. Curtis.	„ H. Miller, Esq.
„ †C. J. Davies, Esq., C. S.	„ Bhow Dajee, Esq.
1847 The Hon. Sir W. Yardley, Kt.	„ G. R. Ballingall, M.D.
„ The Hon. J. G. Lunnsden,	„ Narrajen Dinnathjee, Esq.
Esq., C. S.	„ Rev. S. Flirbank.
„ Colonel D. Davidson.	„ J.F. Watson, M.D. (Europe.)
„ W. C. Coles, M.D.	„ †Captain M. Taylor, N. S.
„ E. Impey, Esq.	„ †Lieut. W. H. Grounds, I. N.
„ W. Arbuckle, M.D.	„ †Major R. Wallace. (Europe.)
„ Cursetjee Jamsetjee, Esq.	1853 Lieut. Colonel G. Pope.
„ The Rev. P. Anderson, A.M.	„ M. A. Coxon, Esq., C. S.
„ †Lieut. J. G. Constable, I. N.	„ R. S. Sinclair, LL.D.
„ †Captain J. B. Dunsterville.	

† Non-Resident Members in India.

1853	Lieutenant P. Browne.	1855	R. T. Reid, LL.D.
"	Colonel G. I. Jameson.	"	J. H. Standen, Esq.
"	Major J. Holmes. (Europe.)	"	R. Leech, Esq.
"	Lieutenant J. T. Annesley.	"	S. D. Sassoon, Esq.
"	Mirza Ali Mahomed Khan, Esq.	"	G. M. S. Seaward, Esq.
"	Gordon S. Forbes, Esq., C.S. (Europe.)	"	James F. Hore, Esq.
"	†J. M. Knapp, Esq.	"	Venayek Wassoodew, Esq.
"	†W. H. Bradley, Esq.	"	The Venerable Archdeacon Reynolds. (Europe.)
"	†H. W. Reeves, Esq., C. S.	"	Ardasseer Cursetjee Dady- sett, Esq.
"	†Lieutenant A. M. Grieve, I. N.	"	†Major H. W. Preedy.
1854	W. P. Adam, Esq. (Eu- rope.)	"	†T. C. Hope, Esq., C. S.
"	R. A. Dallas, LL.D.	"	†Rev. C. Wilson.
"	John Fleming, Esq.	1856	Colonel Lugard, C.B.
"	E. I. Howard, Esq.	"	Captain H. Rivers.
"	J. K. Malcolmson, Esq.	"	J. J. Lowndes, Esq.,
"	Professor D. Novis, Esq. (Eu- rope.)	"	Captain Thomas Cowper.
"	James Erskine, Esq., C. S.	"	The Hon. Sir M. Saussac, Kt.
"	Mirza Ali Ján, Esq.	"	†Major General Ovans.
"	S. Carvalho, Esq.	"	†Captain A. H. Curtis,
"	H. Hebbert, Esq., C. S.	"	†R. W. Hunter, Esq., C. S.
"	Rev. F. W. Lindstedt.	"	†Lieut. R. Bateman.
"	†B. H. Ellis, Esq., C. S.	"	†A. F. Bellasis, Esq., C. S.
"	†Lieutenant R. F. Burton.	"	†H. B. Boswell, Esq., C. S.
"	†James Landon, Esq.	"	†William Hart, Esq., C. S.
		"	†R. Keays, Esq., C. S.
		"	†M. Kane, M.B.W.

Members settled in Europe.

[The * denotes that the Member has paid the final Donation of Rupees 50, which entitles him to a copy of all future publications of the Society, including the Journal.]

1811	James Verarity, Esq.	1812	Hon. Mountstuart Elphinstone.
"	John W. Alderburn, Esq.	1814	John Crawford, Esq.
"	Lieut. Genl. E. Frederick, C.B.	1816	Major William Tate.
"	Lieut. Genl. John Briggs.	1819	Colonel William H. Sykes, M. P.
"	James Farish, Esq.		

† *Non-Resident Members* in India.

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| 1820 Captain John Grant. | 1831 Claude Scott Stewart, Esq. |
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